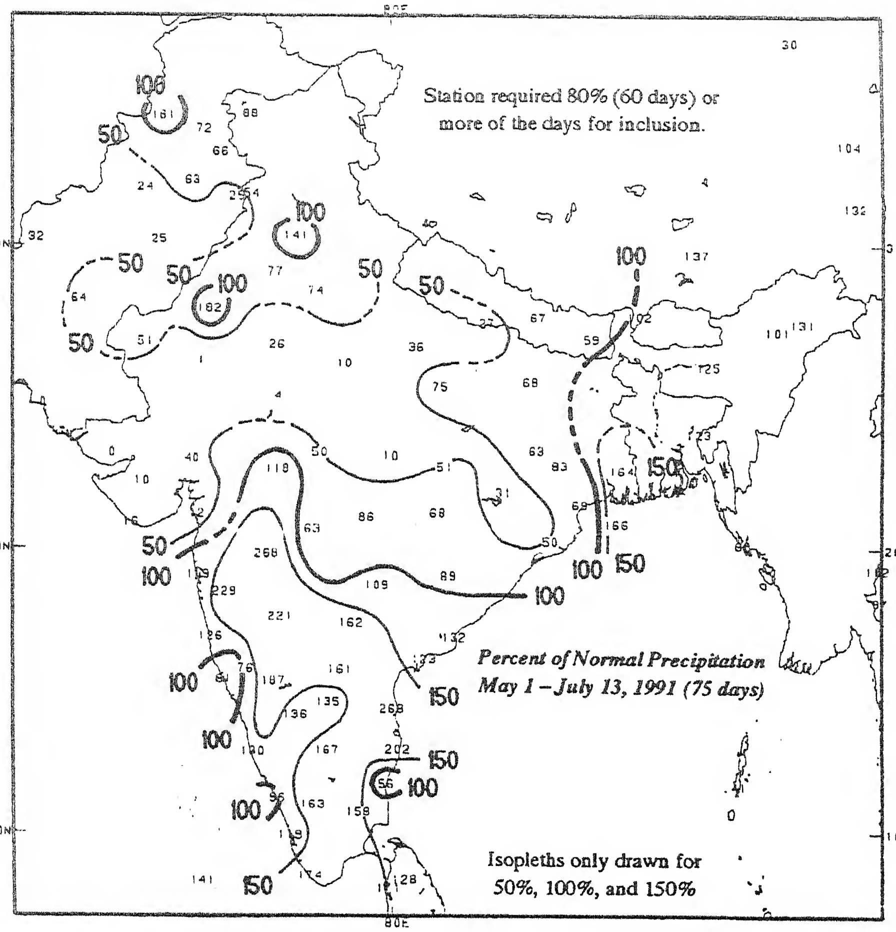
CONTAINS:
EL NINO SOUTHERN OSCILLATION ADVISORY 91/04

CLIMATE ANALYSIS CENTER

CONTAINS:
REVIEWS OF THE 1991 INDIAN MONSOON AND AFRICAN SAHEL RAINY SEASON

WEEKLY CLIMATE BULLETIN

No. 90/28 Washington, DC July 13, 1991



Station required 80% (60 days) or more of the days for inclusion.

Percent of Normal Precipitation May 1 – July 13, 1991 (75 days)

Isopleths only drawn for 50%, 100%, and 150%

Although this year's monsoon began on schedule in southern India, its progress northward has stalled since mid June, leaving northern, central, and western India abnormally dry. Cumulative precipitation since May 1 has been less than half of normal over parts of Orissa, and much of Madhya Pradesh, Uttar Pradesh, Gujarat, and southern Pakistan. In contrast, heavy monsoon rains have drenched southern and western coastal India, with some locations receiving more than twice their normal rainfall for the season to date. In addition, unfavorably wet weather persisted across Bangladesh and India's northeastern states early in the season, caused initially by Tropical Cyclone 2B that devastated southeastern Bangladesh in late April. Although reliable data are lacking, heavy rains appear to have redeveloped across extreme eastern India and portions of Bangladesh during the past two weeks.

UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE–NATIONAL METEOROLOGICAL CENTER
CLIMATE ANALYSIS CENTER

WEEKLY CLIMATE BULLETIN

This Bulletin is issued weekly by the Climate Analysis Center and is designed to indicate, in a brief concise format, current surface climatic conditions in the United States and around the world. The Bulletin contains:

- *Highlights of major climatic events and anomalies.*
- *U.S. climatic conditions for the previous week.*
- *U.S. apparent temperatures (summer) or wind chill (winter).*
- *Global two–week temperature anomalies.*
- *Global four–week precipitation anomalies.*
- *Global monthly temperature and precipitation anomalies.*
- *Global three–month precipitation anomalies (once a month).*
- *Global twelve–month precipitation anomalies (every three months).*
- *Global three–month temperature anomalies for winter and summer seasons.*
- *Special climate summaries, explanations, etc. (as appropriate).*

Most analyses contained in this Bulletin are based on preliminary, unchecked data received at the Climate Analysis Center via the Global Telecommunications System. Similar analyses based on final, checked data are likely to differ to some extent from those presented here.

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GLOBAL CLIMATE HIGHLIGHTS

MAJOR CLIMATIC EVENTS AND ANOMALIES AS OF JULY 13, 1991

1. Southwestern Alaska and Siberia:

ABNORMALLY WARM AIR SPREADS WESTWARD.

Weekly temperatures averaged 2°C to 6°C below normal in central and eastern Alaska, bu twestern Alaska and almost all of Siberia recorded departures of +3°C to +12°C [4 weeks].

2. Central and East-Central United States:

HOT, DRY CONDITIONS CONTINUE TO PLAGUE MOST LOCATIONS.

Most of the Ohio Valley, central Appalachians, and mid-Atlantic observed +2°C to +4°C departures for the week [Warm - 7 weeks]. In addition, only 5-30 mm of rain were measured across much of the Corn Belt, Ohio Valley, and mid-Atlantic, with a few scattered exceptions. Totals of 50-150 mm were produced by slow-moving heavy thunderstorms in southeastern Pennsylvania, southern New Jersey, western Pennsylvania, northeastern and southwestern Ohio, the lower Ohio Valley, much of Indiana, central Illinois, northern and central Missouri, and extreme south-central and southwestern Iowa. Isolated exceptionally heavy amounts (190-310 mm) inundated parts of southern New Jersey, northern Kentucky, and eastern Missouri. Despite the scattered rains, many areas continue to register sizable deficits of 50-90 mm since early June, with portions of central Maryland and northern Ohio recording less than half of normal rainfall since April 1 [Dry - 7 weeks].

3. Central Mexico:

MORE SOAKING RAINS PRODUCE WIDESPREAD FLOODING.

According to press reports, a third consecutive week of deluging rainfall generated numerous floods across central Mexico. Since late June, parts of central Mexico have measured up to 10 times normal rainfall, with observed amounts of 150-510 mm. Daily totals above 100 mm were observed at some locations [3 weeks].

4. The Sahel:

MODERATE TO HEAVY RAINS BRING LIMITED RELIEF.

Rainfall amounts of 40-80 mm dampened most of Senegal and southwestern Mali while 20-45 mm fell along the Niger/Nigeria border. In addition, moderate rains (30-80 mm) also moistened central and north-eastern Ethiopia and east-central Sudan; however, little or no rain was observed immediately north of the afore mentioned region through northeastern Sudan and extreme northern Ethiopia. Despite the timely rains, which arrived just as sizable short-term deficits had developed, six-week shortfalls of 40-95 mm remained at most locations (since early June), with 120-150 mm deficits affecting isolated portions of northern Senegal and Sudan (see Special Climate Summary for more details) [Ending after 4 weeks].

5. The New Lands:

BENEFICIAL RAINS DAMPEN THE PARCHED REGION.

Much of the New Lands lying between latitudes 53°N and 62° received a much-needed 15-30 mm of rain while the largest week totals since the commencement of the rainy season (30-110 mm soaked those areas between 60°E and 70°E longitude, bringin widespread, though incomplete, relief throughout the New Lands Farther south, typically arid locations north of the Aral Se received 10-50 mm, which represented up to seven times th weekly normal; however, most of north-central Kazakhsta remained very dry. Some stations have received less than 15% the normal 30-60 mm rainfall amounts since early June [1 weeks].

6 Western and Eastern India:

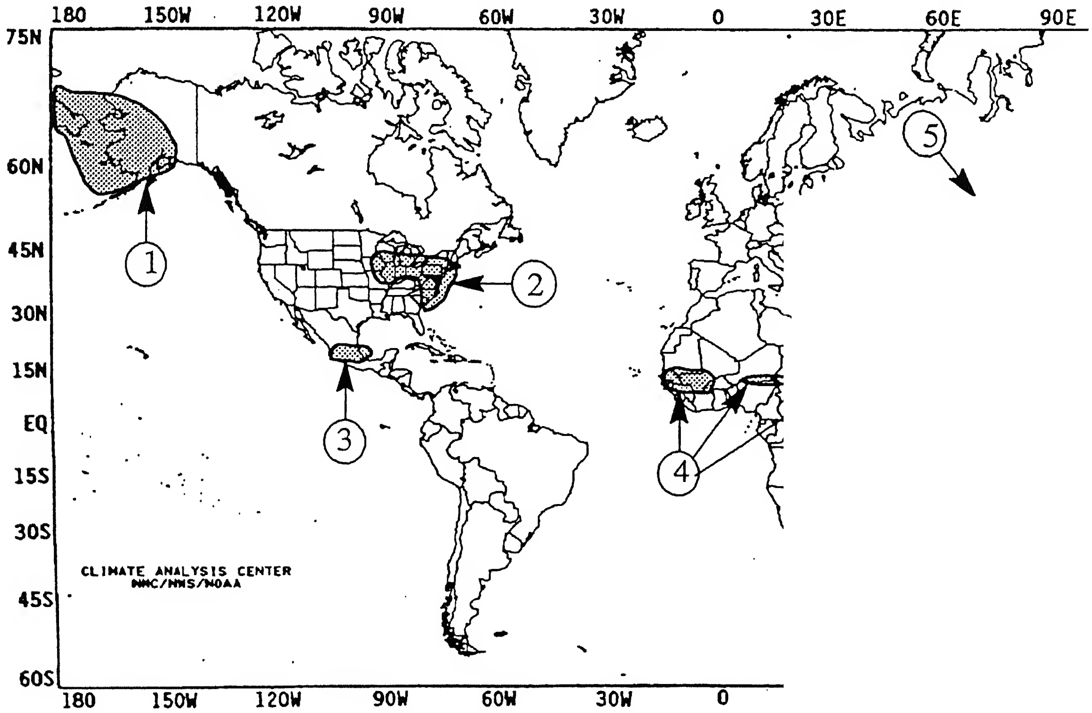
DELUGING RAINS SOAK THE WEST COAST AND EXTREME NORTHEAST WHILE DRY CONDITIONS PLAGUE THE NORTHWEST.

Excessive amounts of rain (200-700 mm) bombed the west-centr and southwestern India coastline last week while 300-600 mm rain since June 30 has generated severe flooding in extrem northeastern India and portions of Bangladesh. According to pres reports, several hundred thousand individuals were left homeless b the northeastern Indian rains, which lifted the Brahmaputra Rive out of its banks [Episodic Event]. In sharp contrast, a very d monsoon season has been observed in western India north latitude 20°N, including central and western Gujarat, where little no rain has been observed for more than a month. Since earl June, deficits of 60-340mm have accumulated throughou west-central and northwestern India [6 weeks].

7. Southwestern Japan, South Korea, and the Yangtze River Valley:

ANOTHER WEEK OF INUNDATING RAINS PRODUCES SEVERE RIVER FLOODING.

According to press reports, the recent heavy rains along th Yangtze River Valley have taken more than 1700 lives, left at lea 2,000,000 people homeless, and sent the Yangtze River far abov the previous record levels observed in 1954. Last week, lesser tota were measured across Japan, but another 100-370 mm drenche southern South Korea, the Yangtze River Valley, and wester Guiahou province. Since late June, up to 740 mm of rain ha fallen across eastern Hubei. Several locations in eastern sections the Yangtze River Valley have measured 3 to 6 times norm rainfall since the beginning of June, with accumulated surpluses 400-770 mm common [6 weeks].



EXPLANATI

TEXT: Approximate duration of anomalies is in brackets. Precipitation
MAP: Approximate locations of major anomalies and episodic events a
temperature anomalies, four week precipitation anomalies, long-

UNITED STATES WEEKLY CLIMATE HIGHLIGHTS

FOR THE WEEK OF JULY 7–13, 1991

Strong thunderstorms erupted across various parts of the country, generating heavy amounts of rain in relatively short time periods. Up to 12 inches of rain fell on Long Beach Island, NJ on Saturday in six hours, temporarily closing a causeway to the island. Elsewhere, over 7 inches of rain fell across portions of northern Florida, causing flooding in and around Jacksonville, FL. Torrential rains also inundated portions of the middle Mississippi and Ohio valleys (Figure 1). Some storms spawned tornadoes, with the largest outbreak occurring on Monday when nearly a dozen twisters were reported from the central Rockies to the Ohio Valley. Two tornadoes touched down in Florida on Saturday, causing damage around Daytona Beach and Tampa, according to press reports. Lightning struck two houses in Hickory, NC, setting the dwellings ablaze. In addition, lightning was also responsible for taking the life of one person in Florida and injuring another in Virginia. Thunderstorms and heavy rain were not confined to the contiguous U.S., however. Anchorage, AK received nearly an inch of rain in one hour on Thursday, marking the 12th consecutive day with rain, including 5 days with thunderstorms (an unusual occurrence in Alaska). Meanwhile, hot conditions baked parts of the Great Plains with readings topping 100°F in Oklahoma and Kansas (page 5). Farther east, humid conditions combined with the heat to produce dangerous apparent temperatures across parts of the South.

The week began with hot weather enveloping much of the southern half of the Great Plains, South, and mid–Atlantic. Readings approached 100°F in Washington, DC and topped the century mark in Kansas. Severe thunderstorms erupted along a frontal system draped across southern New England, the Ohio Valley and central Plains. Brief and intense rains soaked parts of Kentucky with nearly half a foot of precipitation in one hour on Monday. Flooding closed several roads in Frankfurt, KY after becoming submerged in 6 feet of water. In addition, a water plant in Scott County, KY suffered extensive damage according to reports. Also, as many as 8 tornadoes were sighted across the state on Monday. Farther north, significantly cooler conditions prevailed behind the frontal system. Highs in the seventies were reported from Minnesota to Maine on Tuesday while lows dipped into the forties. Sault Saint Marie, MI observed a record daily low of 41°F Tuesday morning. Farther west, warm and dry conditions settled across much of the West. Highs soared into the nineties as far north as central Washington.

The last half of the week provided more severe weather and drenching rains. Over 3 inches of precipitation caused flooding in New Mexico closing portions of I–25 near Springer, NM, while up to 6 inches of hail accumulated on the ground between Maxwell and Raton, NM. To the east, flash flooding affected parts of Missouri, Kentucky, Minnesota, Michigan and Florida. Portions of eastern Missouri measured up to 8 inches of rain, resulting in flooding around St. Louis, MO while major flooding closed roads and damaged homes near Campton, KY. Hot and muggy conditions continued across much of the South. Apparent temperatures exceeding 105°F affected parts of Mississippi and Tennessee. Farther west, hot weather covered much of the Intermountain West as highs broke 100°F as far north as Idaho.

According to the River Forecast Centers, the greatest weekly totals (more than 2 inches) fell on the southern High Plains, parts of the northern and central Plains, the northern half of the Mississippi Valley, most of the Ohio Valley, southern New England, central Gulf Coast, most of Florida, scattered locations in Colorado, northern Idaho and southern Alaska, and eastern Hawaii (Table 1). Light to moderate amounts were measured across the remainder of New England, the middle Atlantic, much of the deep South, Midwest, Great Lakes, northern and central Plains and Rockies, the southern half of Texas, portions of the Southwest, and the remainder of southern Alaska. Little or no precipitation occurred in northeastern third of Texas, eastern Oklahoma, Arkansas, northern Louisiana, the far West, western Alaska and the Hawaiian Islands.

Unseasonable warmth prevailed from the central Plains to the mid–Atlantic and across much of the Intermountain West (Table 2). Weekly departures between +4°F and +6°F were recorded from Kansas to Virginia. Departures of +2°F to +5°F were common across the remainder of the southeastern two–thirds of the nation. Near to slightly above normal temperatures covered much of the western Rockies, Southwest, the Pacific Northwest, and coastal central California with weekly departures up to +4°F reported in eastern Idaho where the mercury hit a record daily high of 102°F at Pocatello, ID on Saturday. In Alaska, abnormally mild weather enveloped the western part of the state where weekly departures up to +8°F were recorded at Nome and Kotzebue. In addition, a few scattered locations in the south reported near to slightly above normal temperatures.

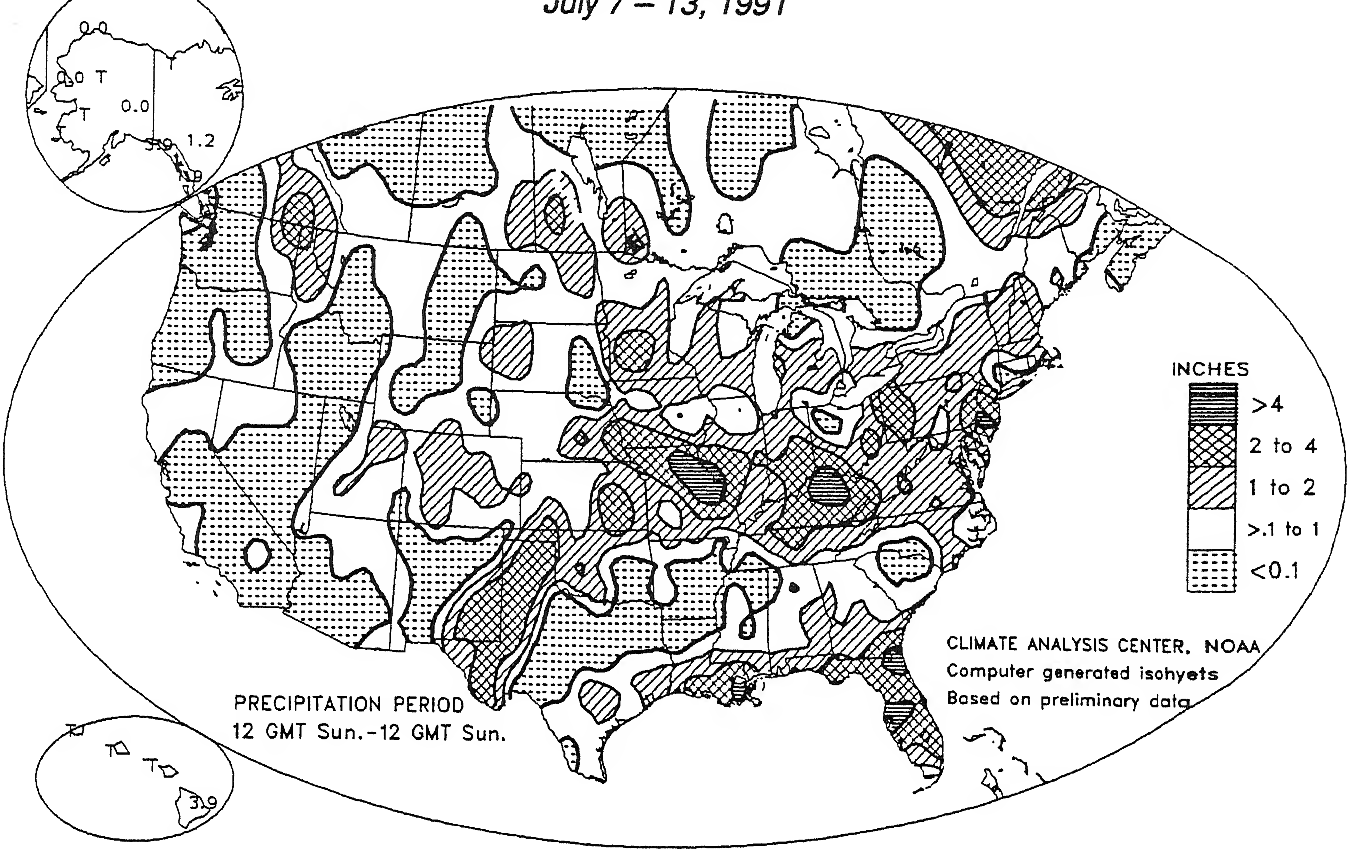
Unusually cool weather dominated the High Plains, the northern tier of states, most of California and east–central Alaska (Table 3). Weekly departures from –4°F to –6°F were felt across parts of the Plains and New England while departures between –2°F and –4°F were common across the remainder of the aforementioned areas. Near to slightly below normal temperatures were felt across parts of central Florida. In Alaska, cooler than normal conditions prevailed over the eastern two–thirds of the state with departures down to –6°F recorded at Big Delta.

TABLE 1. *SELECTED STATIONS WITH 2.75 OR MORE INCHES OF PRECIPITATION DURING THE WEEK OF JULY 7 – 13, 1991*

STATION	TOTAL (INCHES)	STATION	TOTAL (INCHES)
JACKSONVILLE, FL	7.71	YAKUTAT, AK	3.86
GRAND ISLAND, NE	5.46	JACKSONVILLE/CECIL FIELD, FL	3.52
ORLANDO, FL	5.30	MELBOURNE, FL	3.52
TAMPA, FL	5.27	CORDOVA/MILE 13, AK	3.51
NEW ORLEANS/MOISANT, LA	4.71	LEXINGTON, KY	3.39
ROSWELL, NM	4.56	TAMPA/MAC DILL AFB, FL	3.37
JACKSONVILLE NAS, FL	4.51	PHILADELPHIA, PA	3.11
NEW ORLEANS NAS, LA	4.29	CLOVIS/CANNON AFB, NM	3.11
WAYCROSS, GA	4.29	ELKINS, WV	3.10
ST. LOUIS, MO	4.15	NORTH OMAHA, NE	3.04
VERO BEACH, FL	4.12	JACKSON, KY	2.91
APALACHICOLA, FL	4.10	ENID/VANCE AFB, OK	2.86
HILO/LYMAN, HAWAII, HI	3.92	SPRINGFIELD, IL	2.83

OBSERVED PRECIPITATION

July 7 – 13, 1991



DEPARTURE OF AVERAGE TEMPERATURE FROM NORMAL (°F)

July 7 – 13, 1991

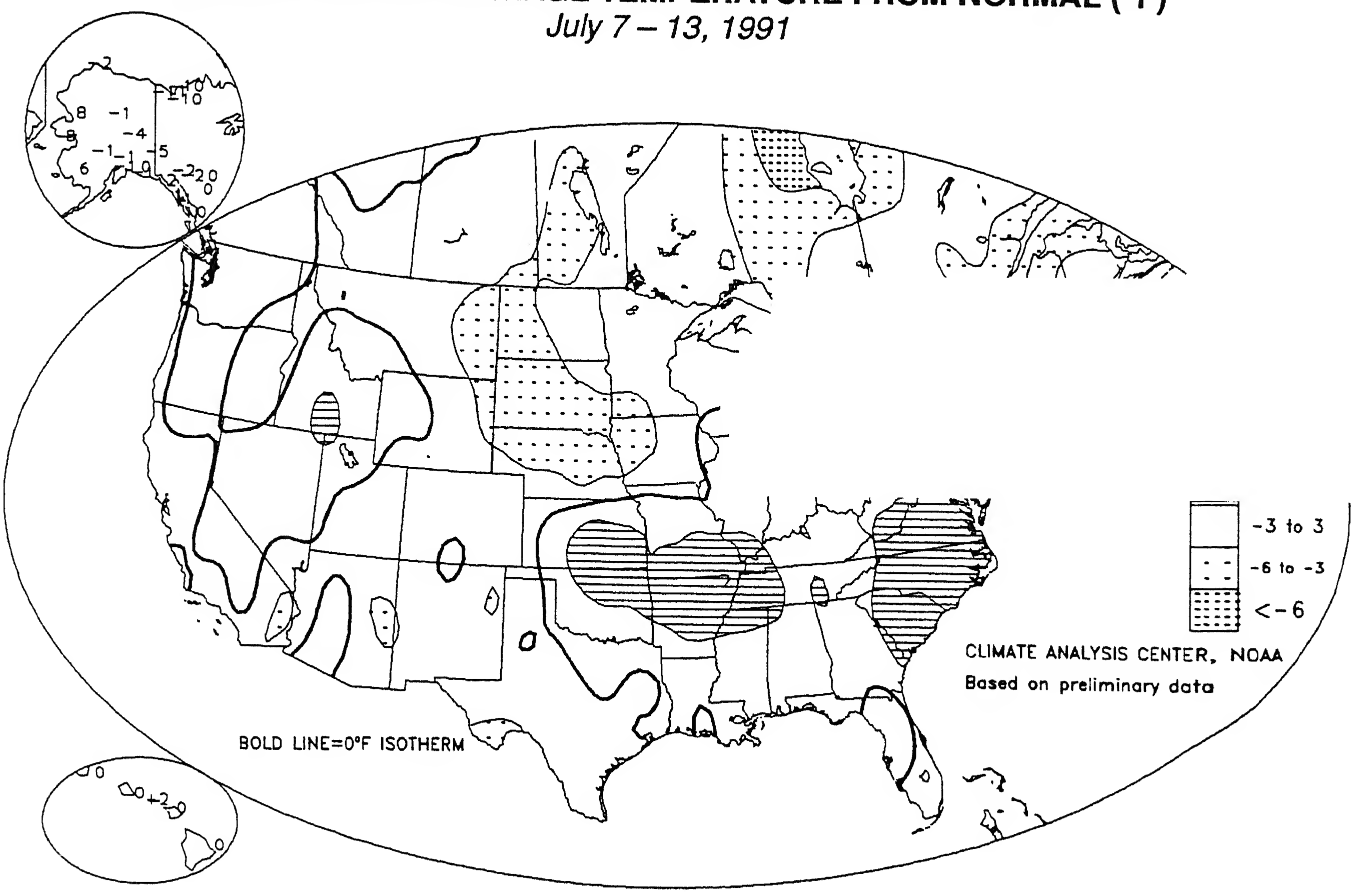


TABLE 2. ***SELECTED STATIONS WITH TEMPERATURES AVERAGING 4.0°F OR MORE ABOVE NORMAL FOR THE WEEK OF JULY 7 – 13, 1991***

STATION	DEPARTURE (°F)	AVERAGE (°F)	STATION	DEPARTURE (°F)	AVERAGE (°F)
NOME, AK	+8.3	58.5	JONESBORO, AR	+4.6	85.4
KOTZEBUE, AK	+8.2	60.6	ROLLA, MO	+4.5	81.6
BETHEL, AK	+6.5	61.1	RALEIGH-DURHAM, NC	+4.4	81.8
SALINA, KS	+5.8	86.3	GREENSBORO, NC	+4.4	81.4
NEW BERN, NC	+5.8	84.7	TULSA, OK	+4.3	87.1
CHARLOTTE, NC	+5.8	84.1	PONCA CITY, OK	+4.3	86.6
CAPE HATTERAS, NC	+5.6	83.5	RICHMOND, VA	+4.3	81.9
WICHITA, KS	+5.4	86.5	ST. PAUL ISLAND, AK	+4.3	49.3
FT LAUDERDALE, FL	+5.2	87.3	SPRINGFIELD, MO	+4.1	81.9
FAYETTEVILLE, AR	+5.0	83.1	MEMPHIS, TN	+4.0	86.0
RENO, NV	+5.0	74.2	MEDICINE LODGE, KS	+4.0	85.3
HARRISON, AR	+4.9	82.7	CHARLESTON, SC	+4.0	84.4
BECKLEY, WV	+4.9	74.1	SUMTER/SHAW AFB, SC	+4.0	83.8
PADUCAH, KY	+4.8	83.5	HICKORY, NC	+4.0	80.4
POPLAR BLUFF, MO	+4.7	84.1			

TABLE 3. ***SELECTED STATIONS WITH TEMPERATURES AVERAGING 3.0°F OR MORE BELOW NORMAL FOR THE WEEK OF JULY 7 – 13, 1991***

STATION	DEPARTURE (°F)	AVERAGE (°F)	STATION	DEPARTURE (°F)	AVERAGE (°F)
BIG DELTA, AK	-6.2	54.1	TUCUMCARI, NM	-3.7	75.7
NORTHWAY, AK	-5.4	53.4	SPENCER, IA	-3.5	69.1
GULKANA, AK	-4.6	53.0	SIOUX FALLS, SD	-3.5	70.2
NORTH OMAHA, NE	-4.6	72.9	MONTPELIER, VT	-3.4	63.2
MT. WASHINGTON, NH	-4.5	44.1	RUMFORD, ME	-3.4	63.6
RAPID CITY, SD	-4.4	67.8	GREAT FALLS, MT	-3.4	65.6
VALENTINE, NE	-4.3	69.9	HURON, SD	-3.4	70.2
MILES CITY, MT	-4.3	69.9	SIOUX CITY, IA	-3.4	72.2
OMAHA, NE	-4.3	73.4	WINSLOW, AZ	-3.4	75.1
FAIRBANKS, AK	-4.0	58.0	GLENS FALLS, NY	-3.2	66.3
GRAND ISLAND, NE	-4.0	72.4	NORFOLK, NE	-3.2	72.4
BLYTHE, CA	-3.8	91.1	PIERRE, SD	-3.1	71.3
OAKLAND, CA	-3.7	59.8	IMPERIAL, CA	-3.0	88.8
WARROAD, MN	-3.7	63.5			

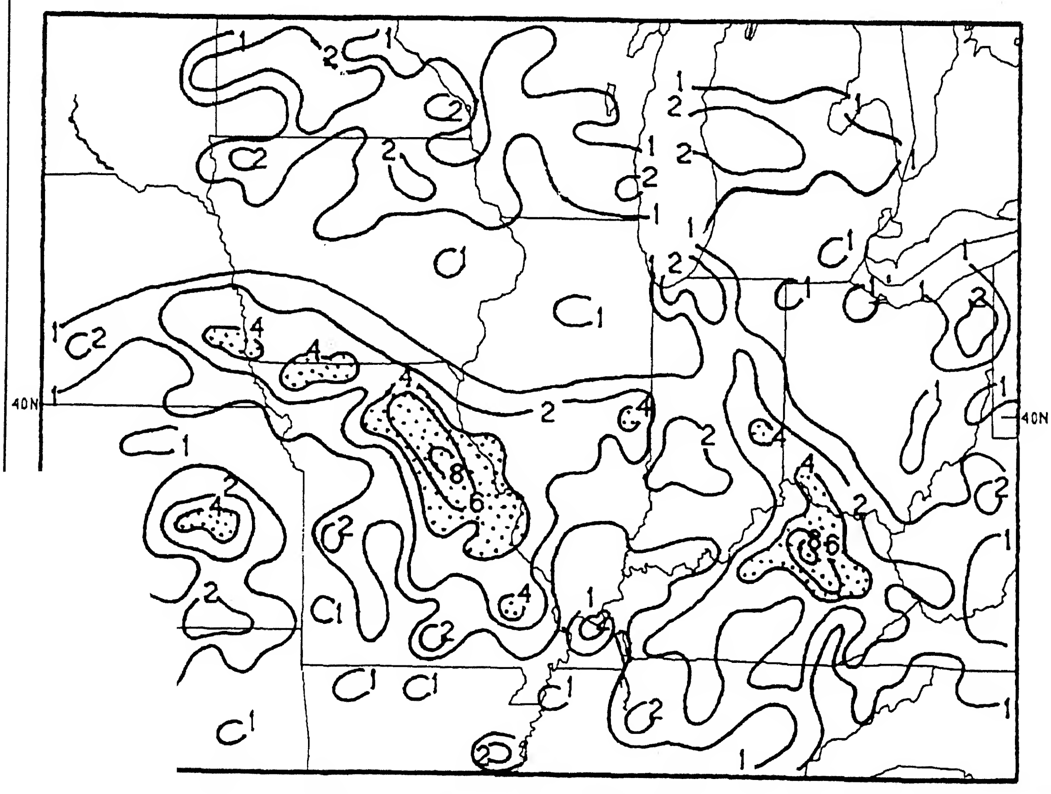


FIGURE 1. Total Precipitation (inches) During July 7–13, 1991. *Stippled areas over 4 inches. Thunderstorms rumbled across the central Plains and Midwest last week, soaking portions of the area with needed rain. Torrential downpours, however, deluged parts of northeastern Missouri and northern Kentucky with six to ten inches of rain, causing localized flooding.*

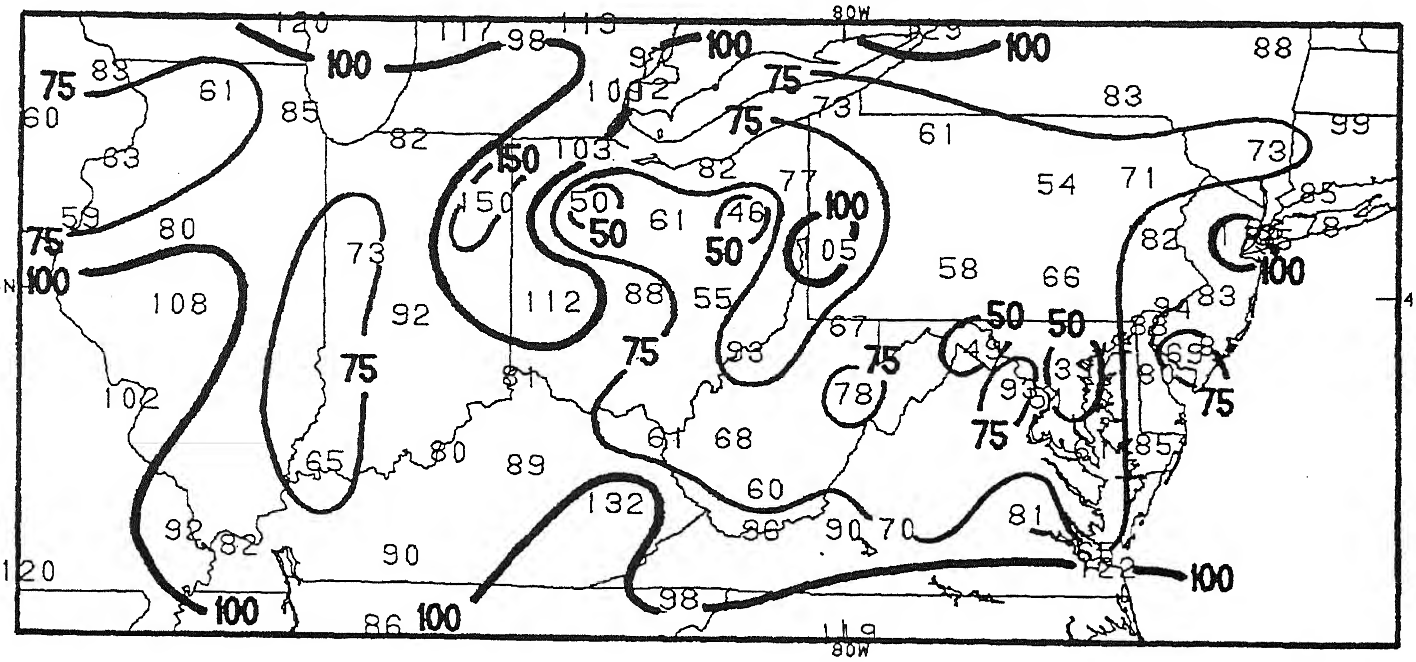
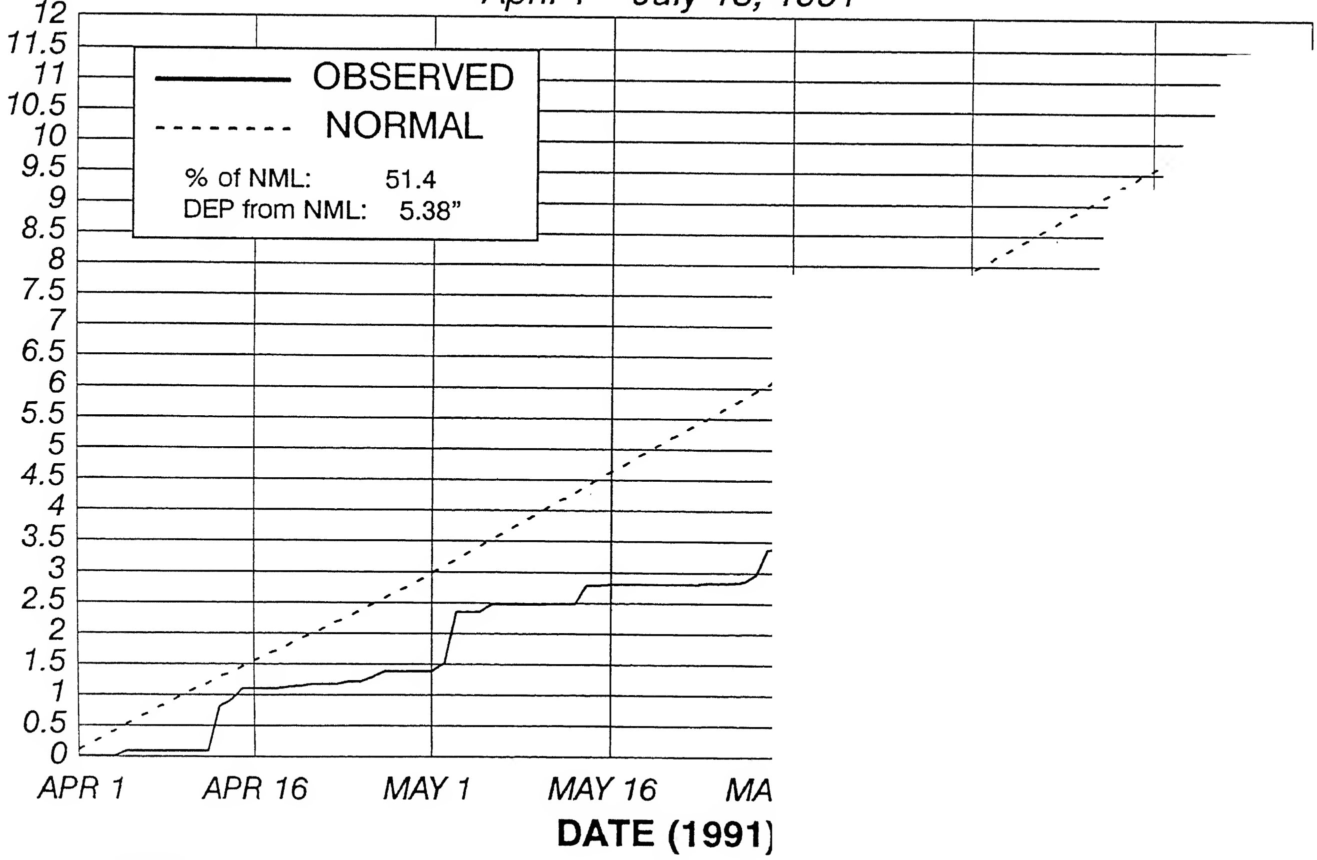


FIGURE 2. Percent of Normal Precipitation, April 1 – July 13, 1991. *Hot and dry conditions continue to prevail across much of the Corn Belt, Northeast, and mid-Atlantic, despite scattered heavy rains (see Figure 1). Many locations have received less than 75% of their normal precipitation for the growing season so far (top). Washington, DC has accumulated only 5.7 inches since April 1, 5.4 inches below normal (bottom).*

WASHINGTON, DC

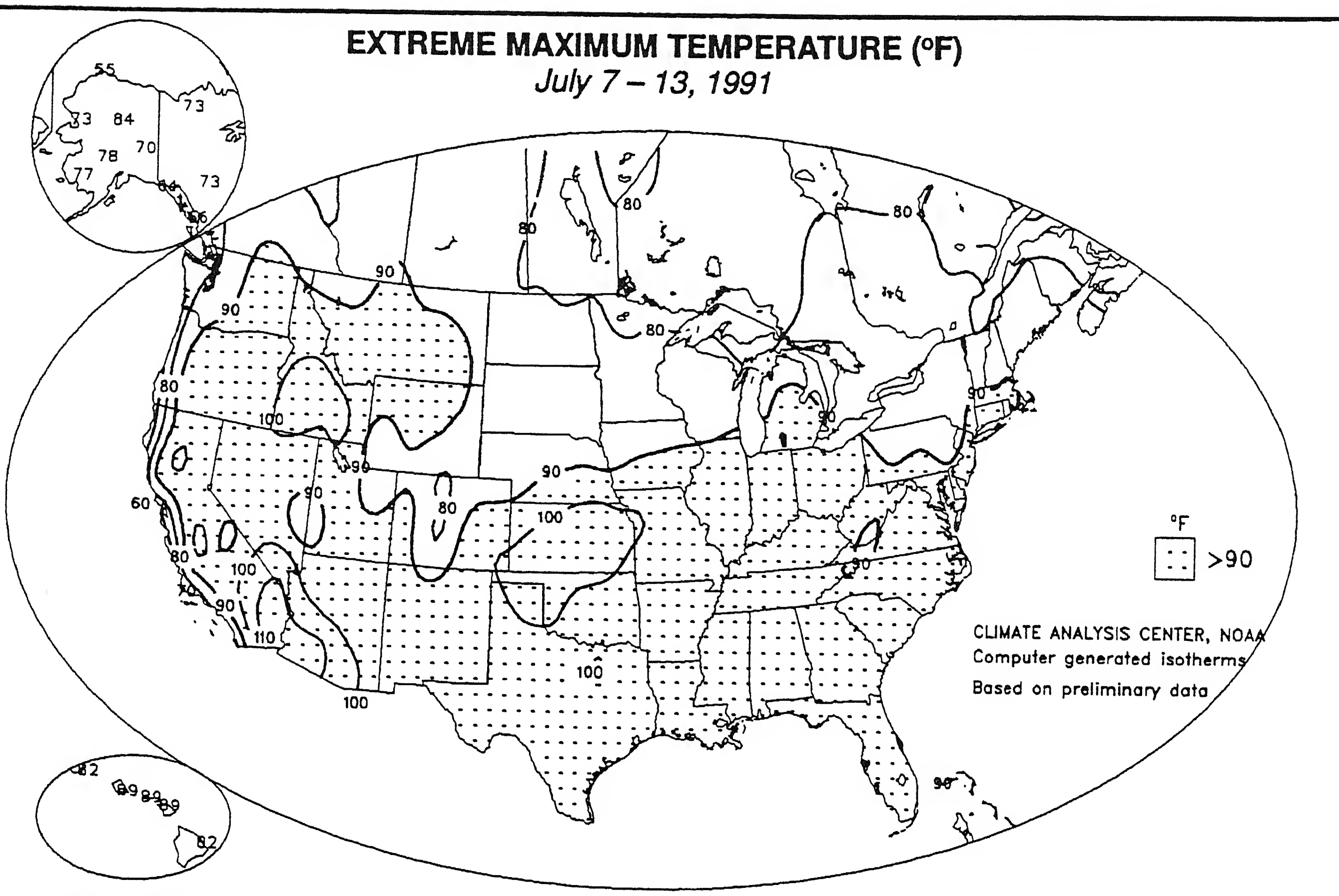
CUMULATIVE OBSERVED vs. NORMAL PRECIPITATION

April 1 – July 13, 1991



EXTREME MAXIMUM TEMPERATURE (°F)

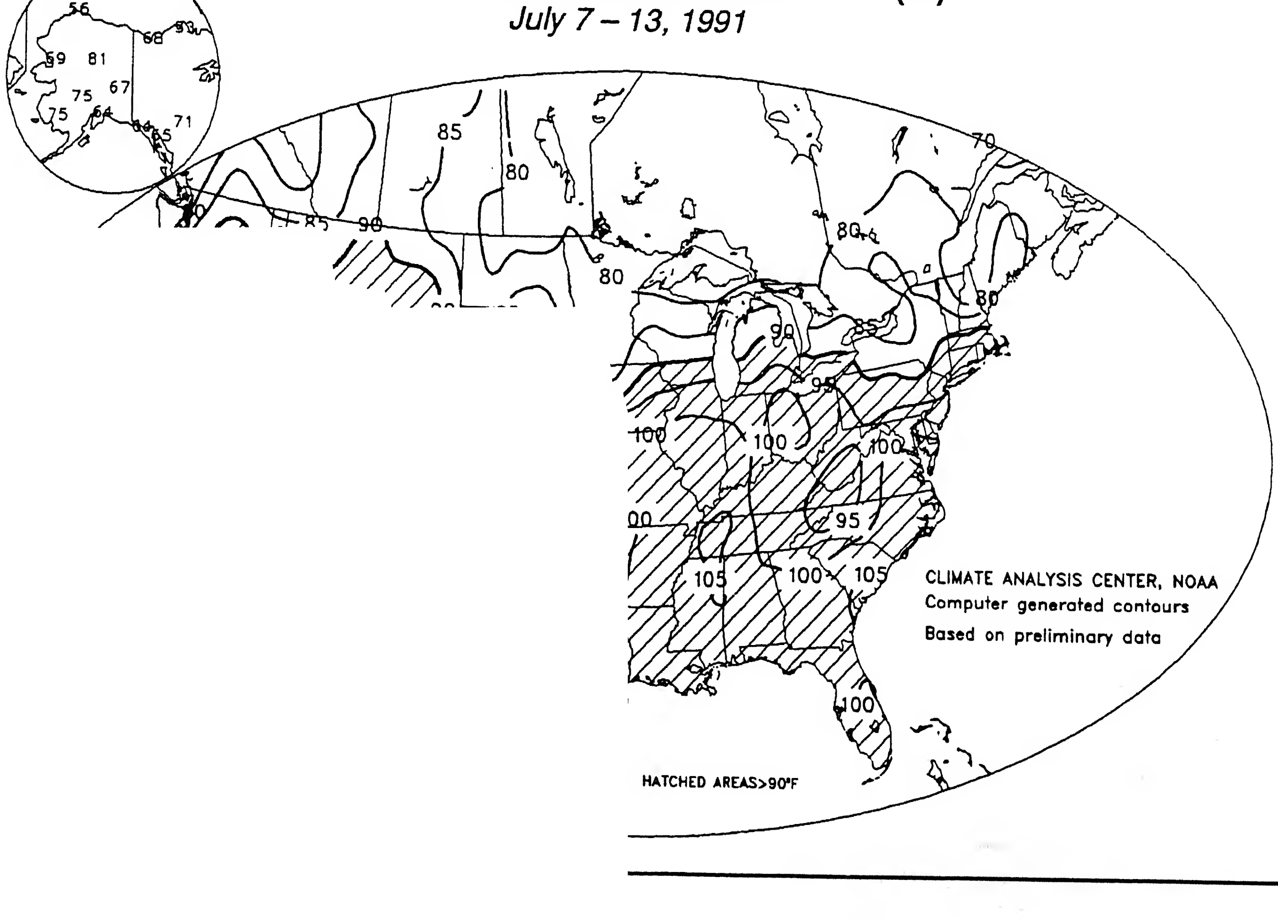
July 7 – 13, 1991



It was another hot week across much of the nation as triple–digit temperatures reached portions of the central and southern Plains, desert Southwest, interior California, and northern Intermountain West (top). High temperatures along with the humidity allowed for sweltering conditions in parts of the central and southern Plains, Ohio and middle and lower Mississippi Valleys, Southeast, and Mid–Atlantic, where apparent temperatures climbed above 100°F (bottom).

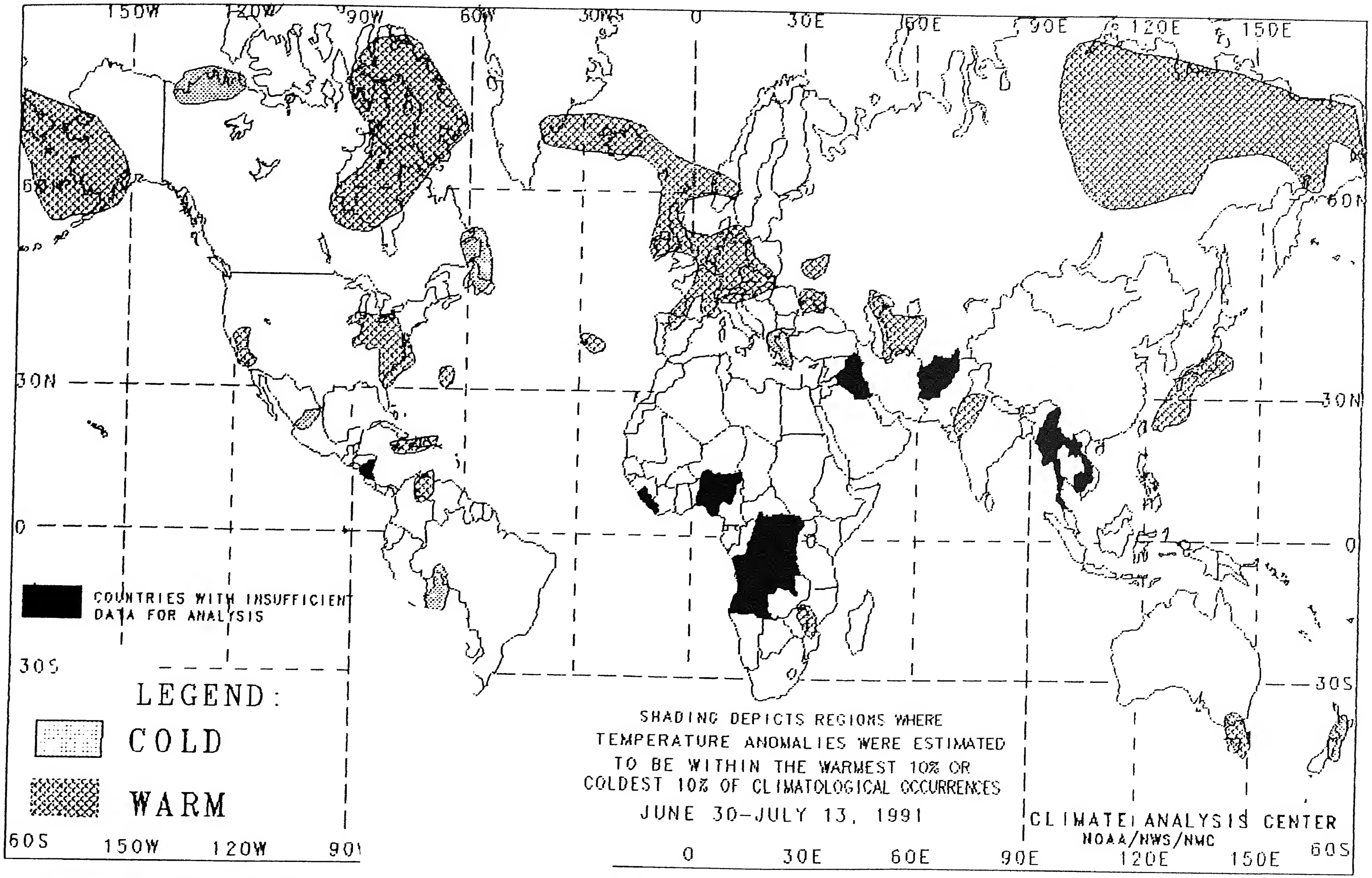
EXTREME APPARENT TEMPERATURE (°F)

July 7 – 13, 1991



2–WEEK GLOBAL TEMPERATURE ANOMALIES

JUNE 30 – JULY 13, 1991



The anomalies on this chart are based on
for which at least 13 days of temperature obse
reports. Many stations do not operate on a twen
observations are not taken. As a result of thes
minimum temperature may have a warm bias.
overestimation of the extent of some warm anor

Temperature anomalies are not depicted

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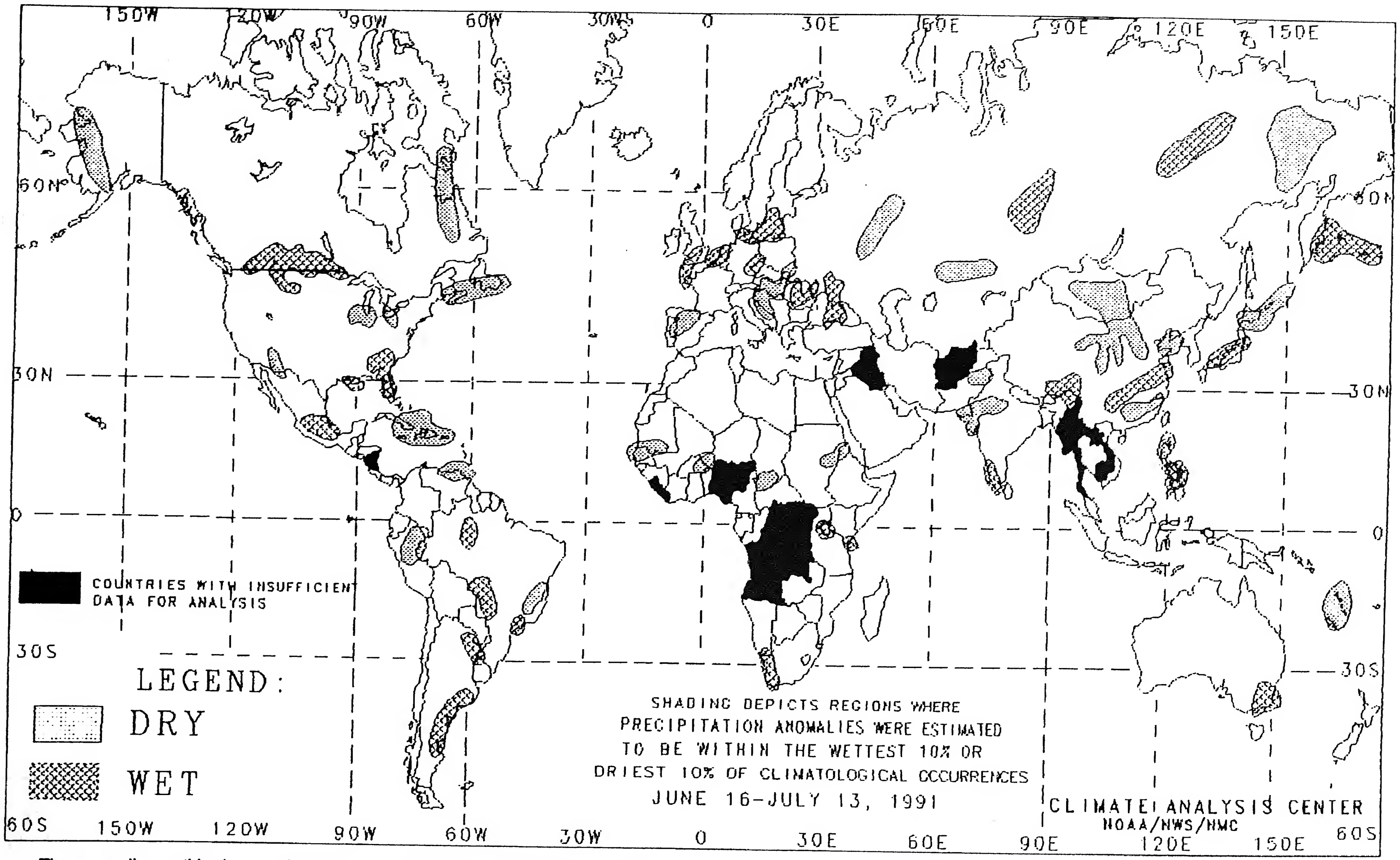
In some regions, insufficient data exist to determine the magnitude of anomalies. These regions are located in parts of tropical Africa, southwestern Asia, interior equatorial South America, and along the Arctic Coast. Either current data are too sparse or incomplete for analysis, or historical data are insufficient for determining percentiles, or both. No attempt has been made to estimate the magnitude of anomalies in such regions.

4–WEEK GLOBAL PRECIPITATION ANOMALIES

JUNE 16 – JULY 13, 1991



The anomalies on this chart are based on approximately 2500 observing stations for which at least 27 days of precipitation observations (including zero amounts) were received or estimated from synoptic reports. As a result of both missing observations and the use of estimates from synoptic reports (which are conservative), a dry bias in the total precipitation amount may exist for some stations used in this analysis. This in turn may have resulted in an overestimation of the extent of some dry anomalies.

In climatologically arid regions where normal precipitation for the four week period is less than 20 mm, dry anomalies are not depicted. Additionally, wet anomalies for such arid regions are not depicted unless the total four week precipitation exceeds 50 mm.

In some regions, insufficient data exist to determine the magnitude of anomalies. These regions are located in parts of tropical Africa, southwestern Asia, interior equatorial South America, and along the Arctic Coast. Either current data are too sparse or incomplete for analysis, or historical data are insufficient for determining percentiles, or both. No attempt has been made to estimate the magnitude of anomalies in such regions.

The chart shows general areas of four week precipitation anomalies. Caution must be used in relating it to local conditions, especially in mountainous regions.

EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC ADVISORY 91/04

issued by

DIAGNOSTICS BRANCH
CLIMATE ANALYSIS CENTER, NMC

July 10, 1991

Most atmospheric and oceanic indices indicate that a warm episode is in progress. During the last few months, sea surface temperature (SST) anomalies have increased throughout the equatorial Pacific from 160°W eastward to 90°W (Fig. 1b). At the same time the 28°C isotherm has advanced eastward to its most eastward position since the 1986–87 warm episode (Fig. 1a). Also during the last few months, the Southern Oscillation Index (SOI) has averaged around –1 (FIg. 2). In addition, the low–level easterlies have been weaker throughout the equatorial Pacific during both May and June. These indices together with statistical and model forecasts are consistent in indicating the development of a warm episode.

However, two features, which generally accompany warm episodes, are lacking. Convection in the central equatorial Pacific and SSTs along the west coast of South America have been near normal

The evolution of the anomaly patterns in the tropical Pacific will conti
closely monitored, especially with regards to further increase
and to the development of strongly enhanced convectior
The next advisory will be issued when significant
observed.

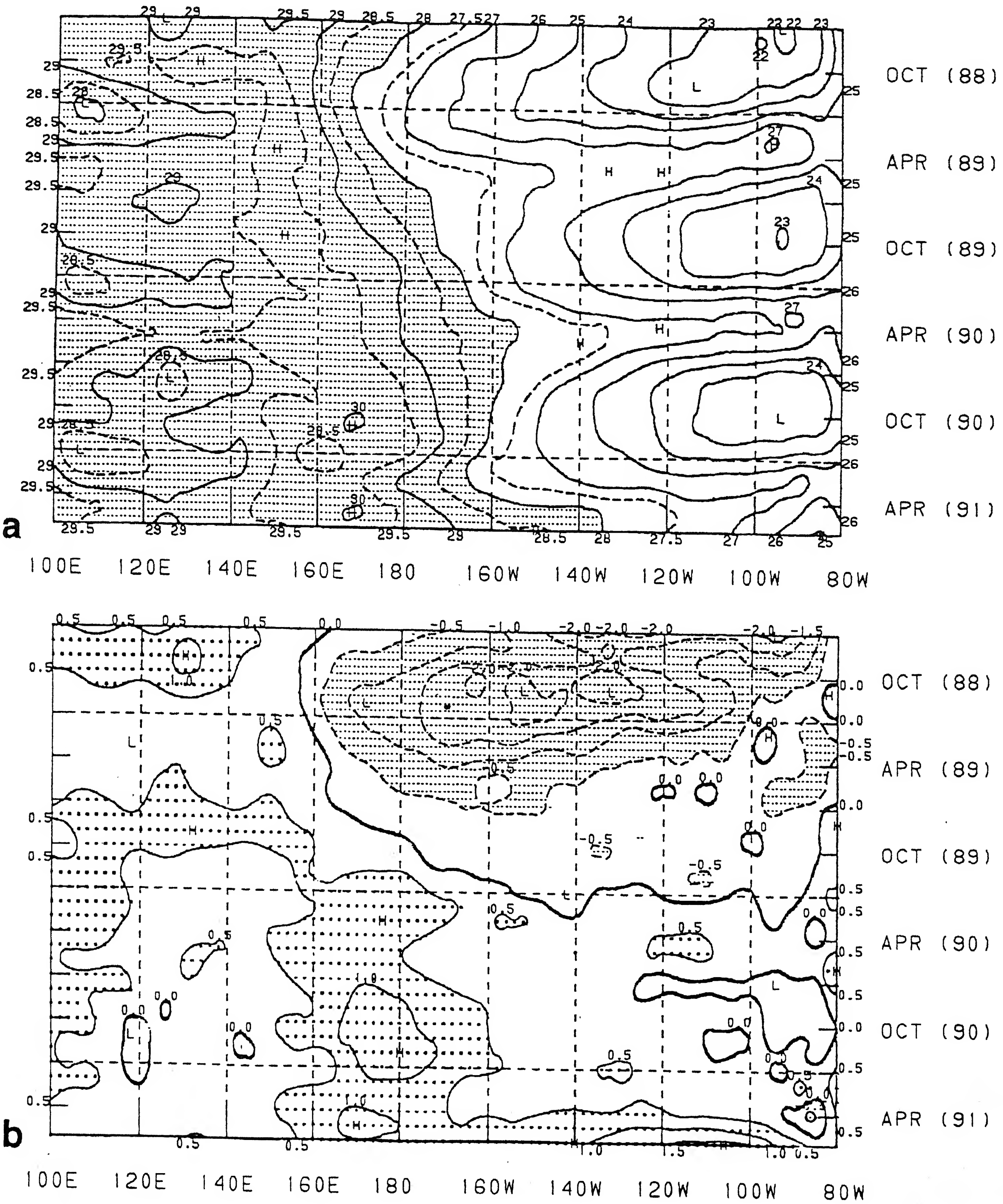


FIGURE 1. Time–Longitude Section of Monthly Sea Surface Temperature, a) Mean and b) Anomalous, for 5°N–5°S. *Contour interval is 1°C and 0.5°C, respectively. SST values greater than 28°C and anomalies less than –0.5°C are shaded. Stippled areas indicate anomaly values greater than 0.5°C. Anomalies are computed based on the COADS/ICE climatology* (Reynolds, 1988, *J. Climate,* 1, 75-76).

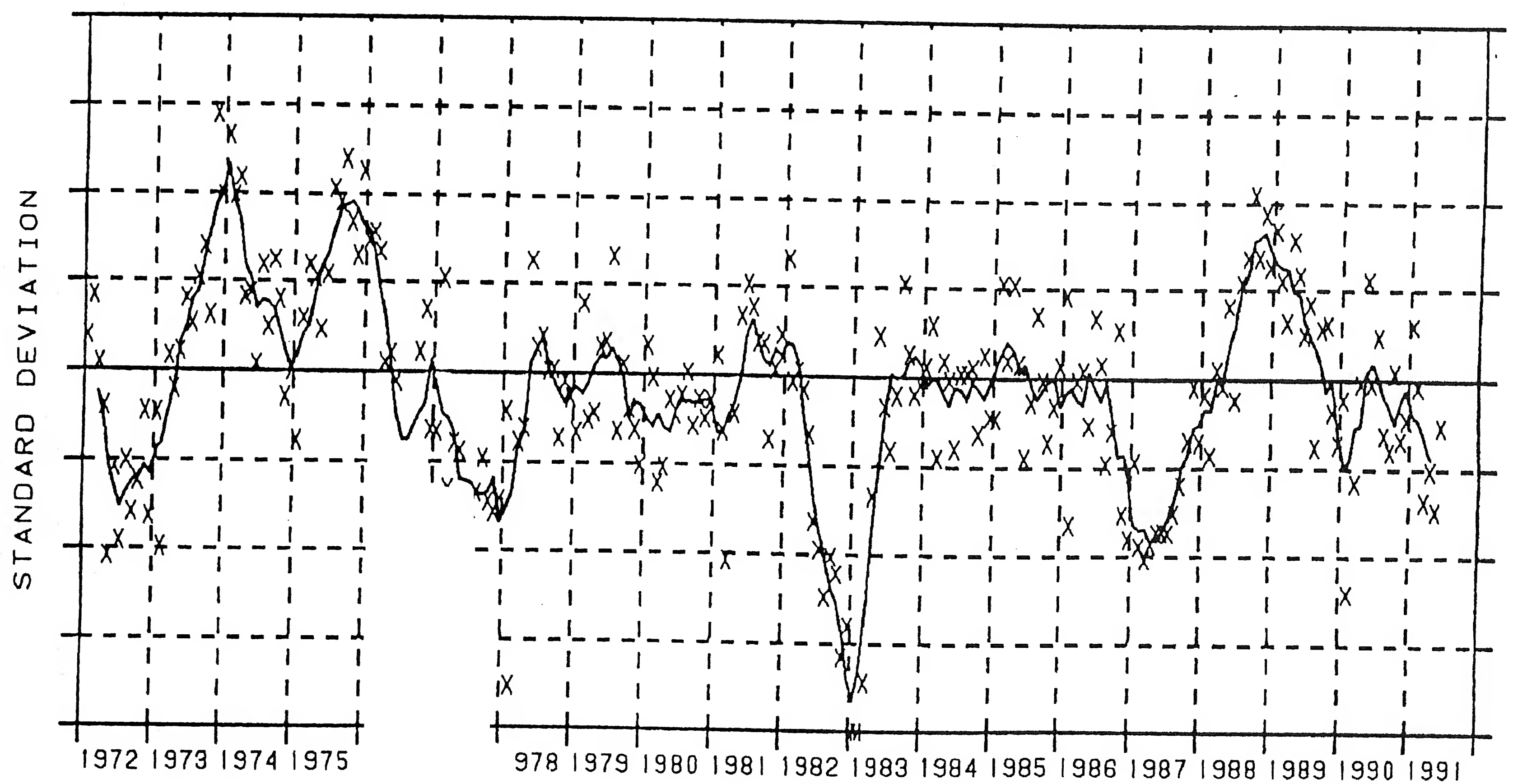


FIGURE 2. Five–Month Runn ifference Between the Standardized Sea Level Pressure Anomalies at Tahiti and Darwin (Tahiti–Darwin). *Values nnual standard deviation. Crosses are individual monthly means.*

SPECIAL CLIMATE SUMMARY

ANALYSIS AND INFORMATION BRANCH
CLIMATE ANALYSIS CENTER, NMC
NATIONAL WEATHER SERVICE, NOAA

UPDATE ON THE 1991 AFRICAN SAHEL RAINY SEASON

Rain falls in a very distinct pattern across the swath of Africa that lies north of the equator but south of the Sahara Desert. Locations close to the Equator generally receive rainfall throughout the year, with a weak winter maximum evident in a few areas. North of about 5°N latitude, however, a pronounced maximum occurs during the summer months (May – September), which becomes more pronounced near the Sahara (Figure 1). North of 10°N latitude, most locations receive more than 90%of the normal yearly rainfall during the summer months. In addition, the rainy season shortens and the total annual precipitation decreases as one moves northward through the Sahel to the desert, where little or no rain is measured. As depicted in Figure 2, the heaviest May–September totals across sub–Saharan Africa are usually measured across western sections of Guinea–Bissau, Guinea, and Cote d'Ivoire as well as throughout Sierra Leone and Liberia, where 1600–3710 mm is typically recorded. In contrast, fewer than 400 mm are normally observed along the northern tier of the Sahel from northern Senegal eastward through northern Ethiopia.

Sahelian rainfall is generally carried northward by the intertropical convergence zone (ITCZ), which typically stretches from northwestern Sierra Leone northeastward through central Burkina Faso and eastward across northern Nigeria, southern sections of Chad and the Sudan, and central Ethiopia by late May. During June and July, the ITCZ slowly brings the northernmost edge of rainfall northward, reaching central Mauritania and northern sections of Mali, Niger, Chad, and the Sudan during July.

As April 1991 came to an end, most locations across western sub–Saharan Africa that usually experience April precipitation had received near or above normal rainfall amounts. Mid–April brought an early start to the rainy season across southern Mali, the southern half of Burkina Faso, and east–central Sudan, where abnormally high totals of 20–60 mm fell by month's end. In contrast, much of central and southern Ethiopia was experiencing abnormally dry conditions; however, since April normals are very low at those locations that experience a pronounced summer rainfall maximum, little concern was generated by these conditions. Unfortunately, few reliable reports were received from Ethiopia during May, June, and the first week of July, presumably because of the civil war, so any reference to Ethiopian moisture conditions are based on nearby Sudanese data or on convective satellite estimates. These estimates are a primary source of rainfall data in nations where few reliable surface reports are available, including Guinea–Bissau, Sierra Leone, Guinea, Liberia, Nigeria, Cameroon, the Central African Republic, and Zaire.

May 1991 was very moist across much of the Sahel, particularly the western half. Weekly totals up to 70 mm dampened Burkina Faso, southern Mali, and southern Niger. During the latter half of the month, rainfall spread exceptionally far north as 20–40 mm fell across central Niger, eastern Mali, and southern Algeria, where rainfall is normally scant until July. By the end of the month, however, the northernmost rainfall had retreated back to near its normal position. Climatologically significant wetness (among the wettest 10% of climatological occurrences) was observed across Burkina Faso, southwestern Niger, southwestern Chad, and east–central Sudan south of 12°N. In contrast, unseasonably low totals were measured across southern Mali as well as through Senegal, where deficient early–season rainfall has been commonplace during the last 10 years.

In sharp contrast, June 1991 rainfall was generally below normal throughout the Sahel, although near normal amounts were measured across southern Niger while unusually heavy rains continued in extreme southern Mali and most of Burkina Faso. Dryness was particularly severe across central and east–central Sudan, northwestern Ethiopia, and most of Senegal and adjacent southwestern Mali, where June 1991 ranked among the driest 10% of climatological occurrences.

Fortunately, July 1991 has gotten off to a moist start in most places, especially across parched Senegal, where as much as 150 mm has fallen. In addition, 30–80 mm has been measured across the Sudan and Ethiopia south of 13°N, providing some relief from short–term dryness. Additionally, rainfall re–developed across eastern Mali, where dry weather had prevailed since the unseasonable mid–May rainfall. Rain also continued at a near to above normal rate across extreme southern Mali, Burkina Faso, southern Niger, and northern Nigeria. As Figure 3 shows, much of the western Sahel has received abundant rainfall during the 1991 wet season, except for most of Senegal, southwestern Mali, and portions of southeastern Niger. Farther east, however, significant rainfall has not trekked north of about 12°N, generating severe moisture shortages across those portions of Chad, the Sudan, and Ethiopia that lie north of the aforementioned latitude. Up to 517 mm of rain was measured across Burkina Faso, extreme southern Mali, and southern Niger by July 13 while much of northern Senegal, central Chad, and east–central Sudan had not received 40 mm (Figure 4).

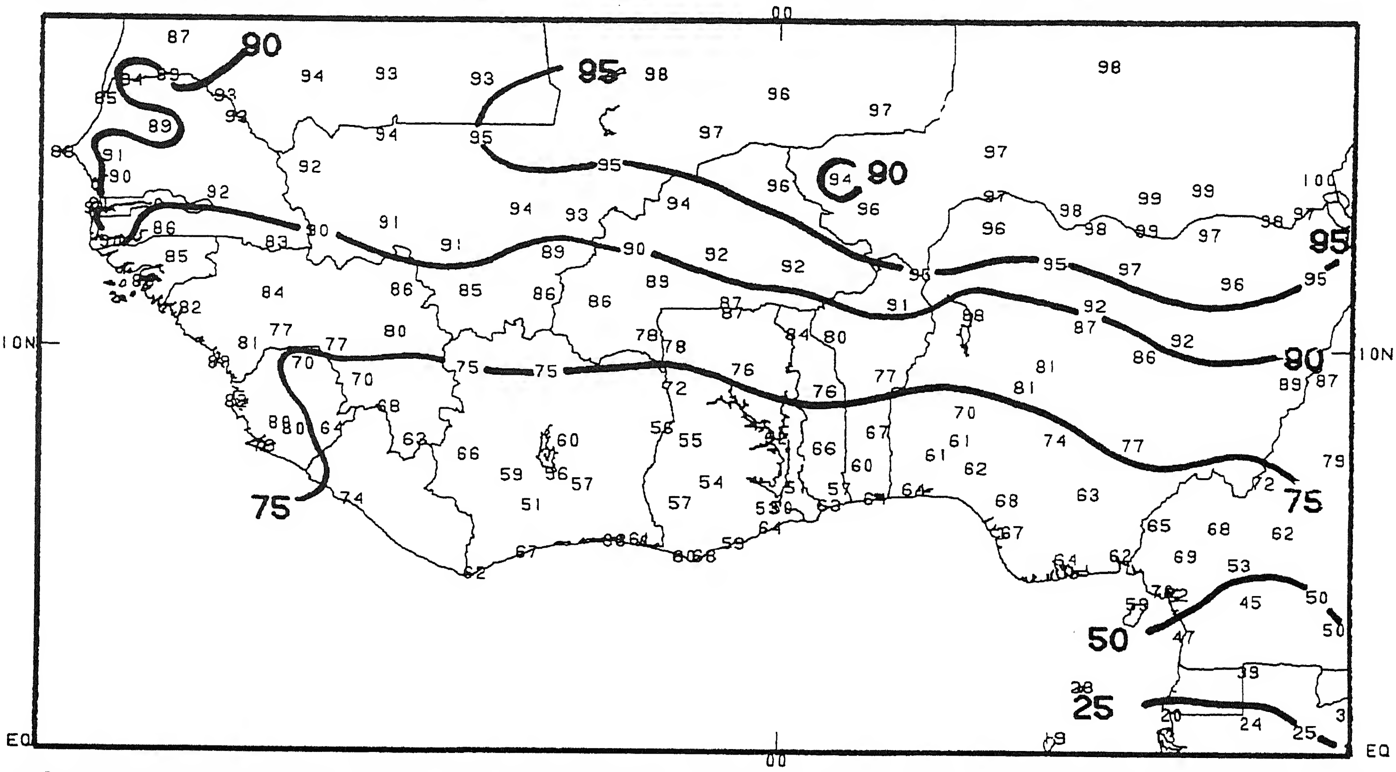
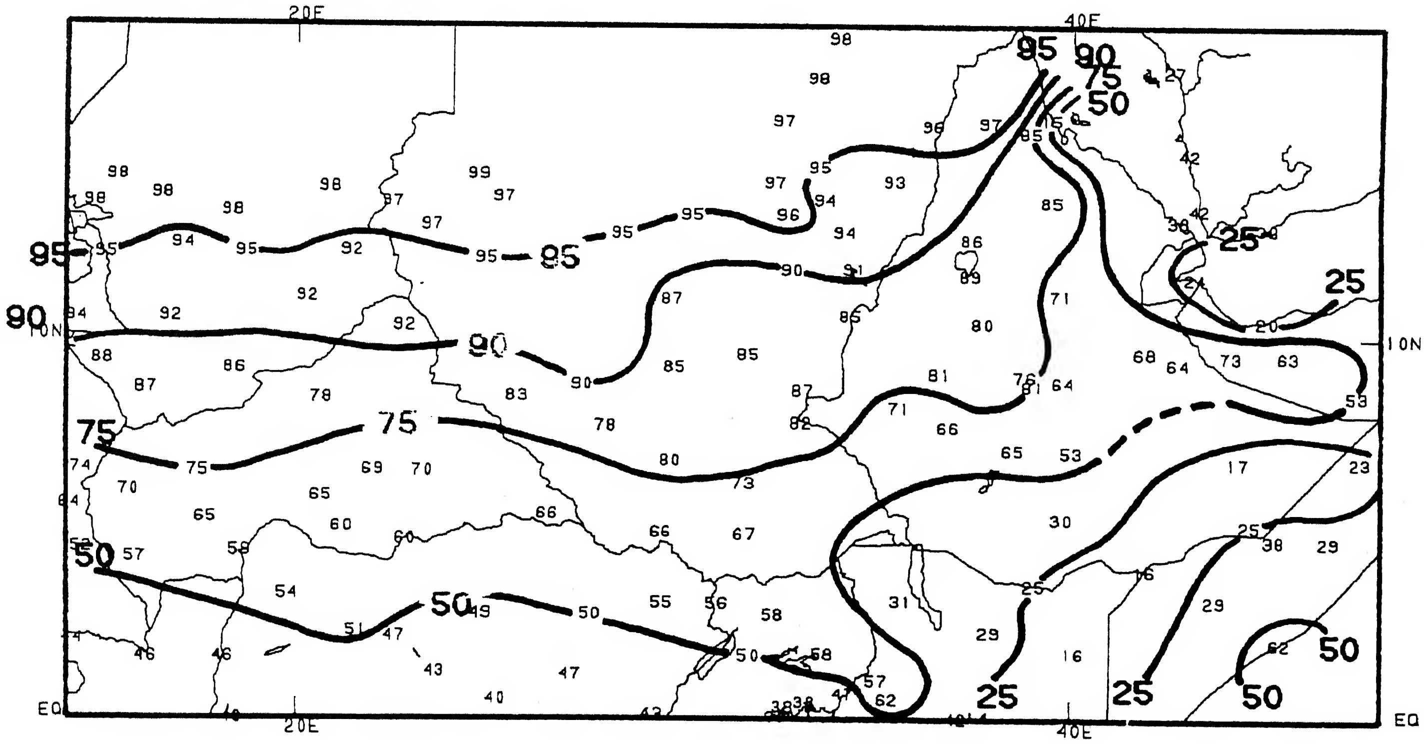


FIGURE 1. Percent of the Annual Precipitation That Normally Occurs During May-September (5 months) For Western (top) and Eastern (bottom) sub-Saharan Africa. *Isopleths are only drawn for 25, 50, 75, 90, and 95%. If precipitation was evenly distributed during the year, then a 3-month period would have 25% (3/12) of the yearly precipitation, and a 6-month period would have 50% (6/12). In the Sahel (approximately north of 9°N latitude and south of the Sahara Desert) more than 75% of the annual precipitation falls during May-September. Values gradually decrease southward, with precipitation evenly distributed throughout the year near the equator. In the Ethiopian highlands, however, there are other minor rainfall maximums during the remainder of the year, so May-September represents a smaller portion of the normal annual total.*



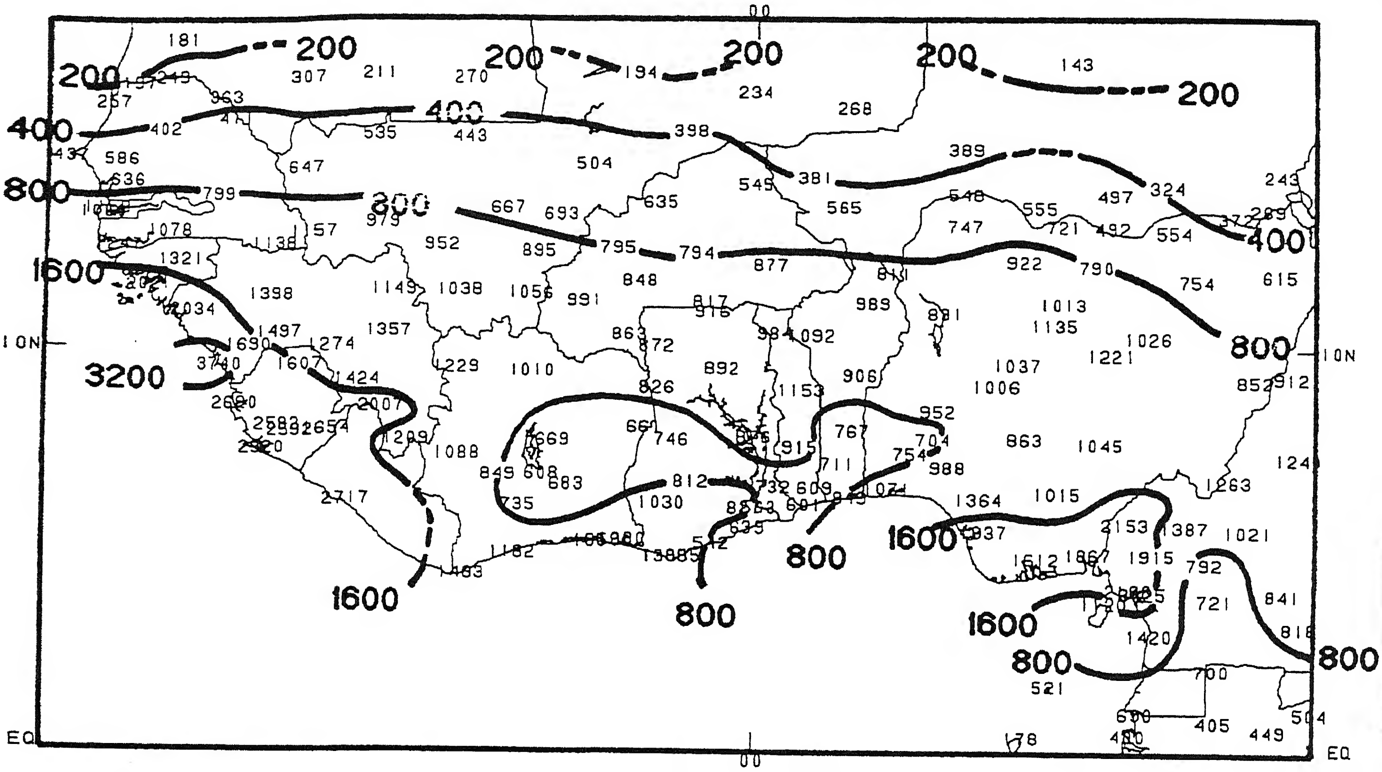
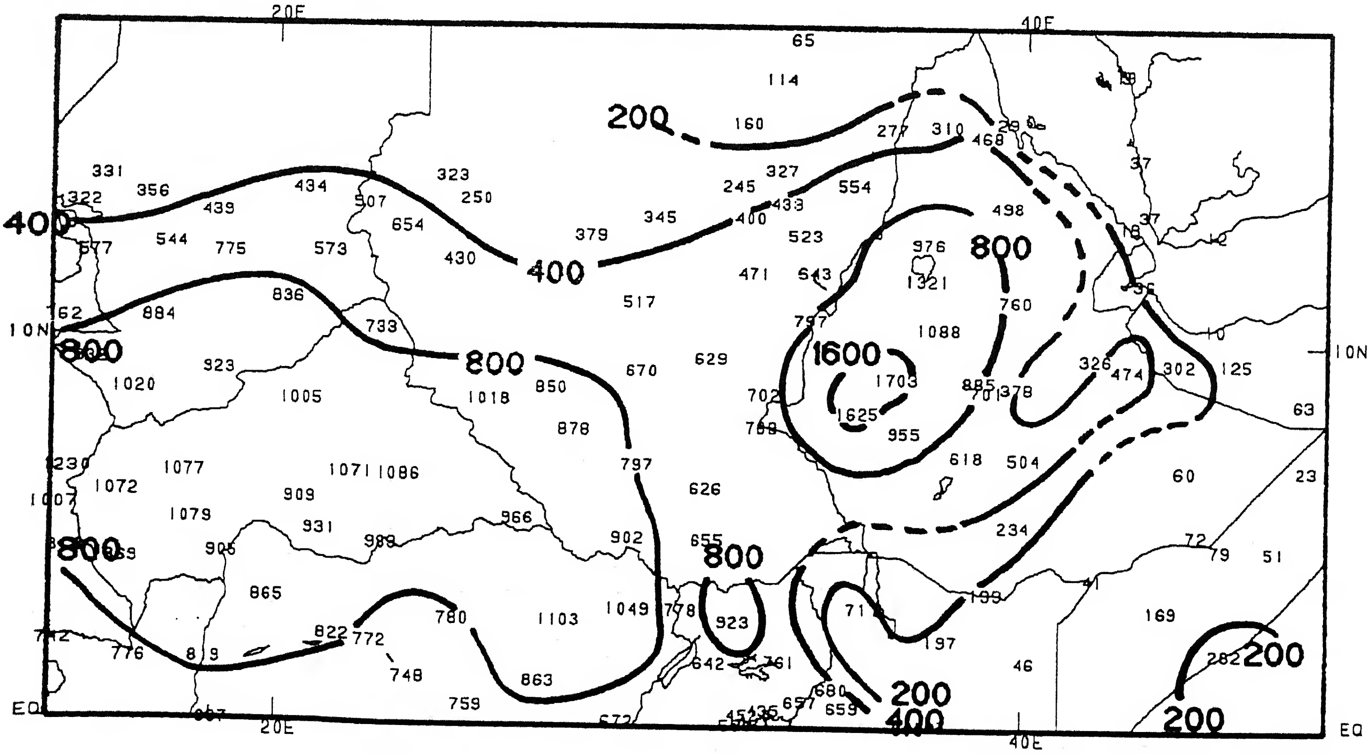


FIGURE 2. Total Normal Precipitation (mm) During May-September For Western (top) and Eastern (bottom) sub-Saharan Africa. *Isohyets are only drawn for 200, 400, 800, 1600, and 3200 mm. During the rainy season, the largest rainfall totals are normally measured along the coasts of Guinea, Sierra Leone, and Liberia, with additional large amounts (more than 1600 mm) across southern Nigeria, southwestern Cameroon, and in the highlands of Ethiopia. Five-month rainfall totals rapidly decrease north of 15°N and are generally less than 100 mm north of 18°N (in the Sahara Desert).*



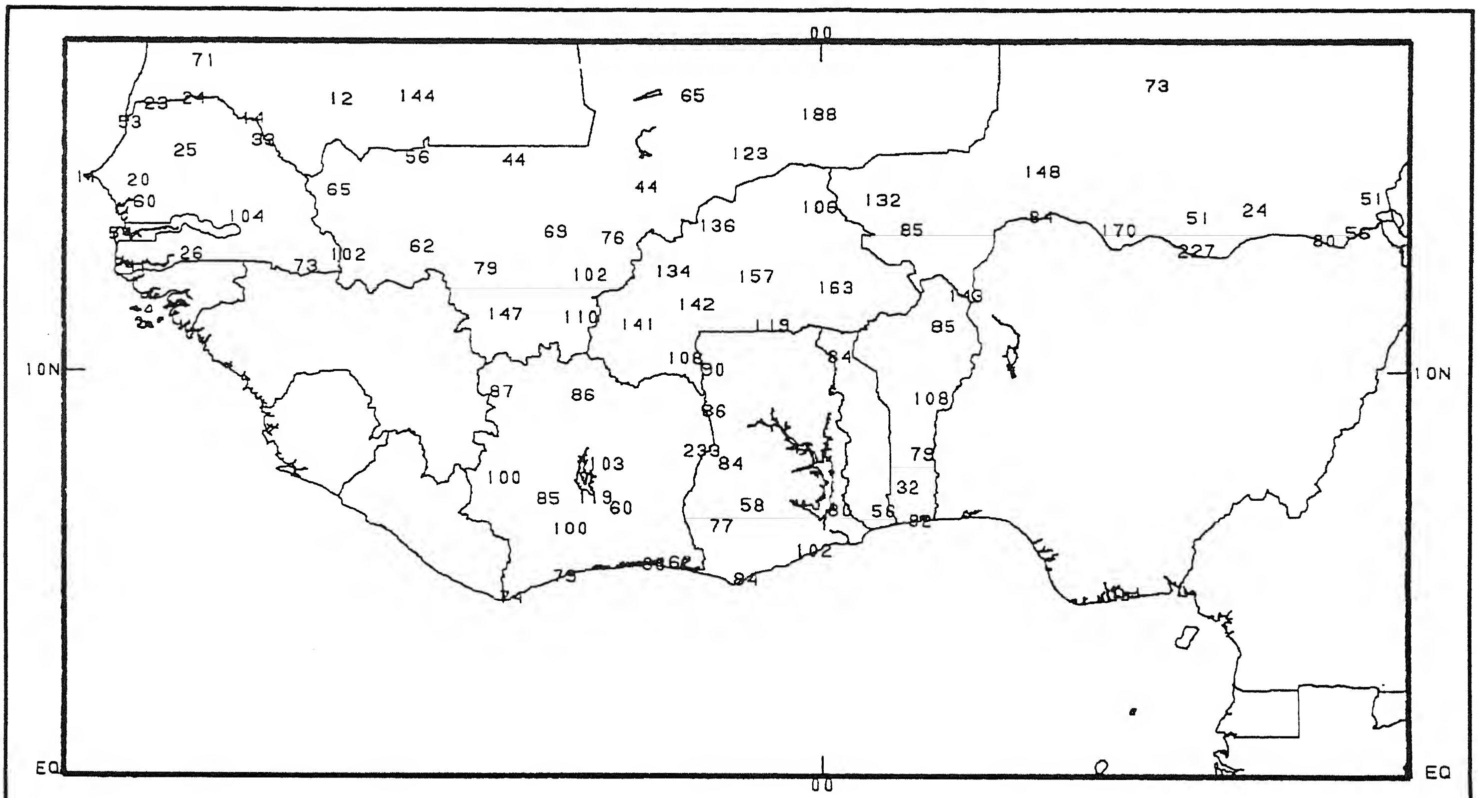
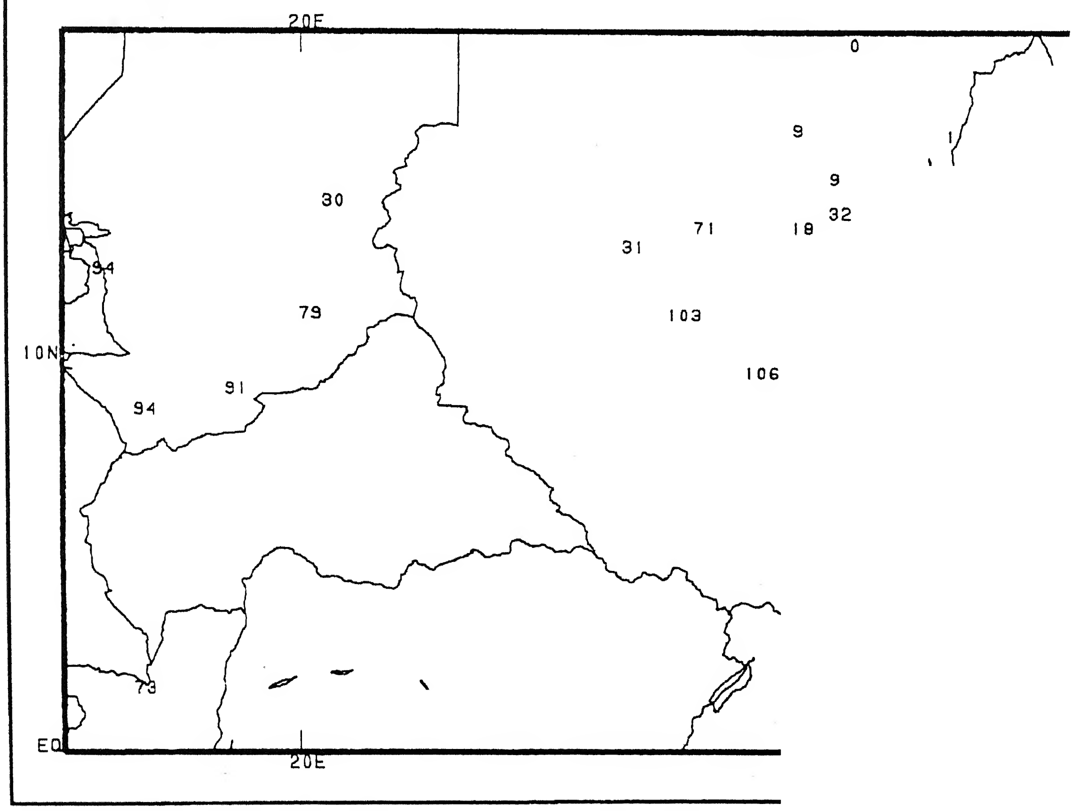


FIGURE 3. Percent Of Normal Precipitation During May 1–July 13, 1991 (74 days) For Western (top) and Eastern (bottom) sub-Saharan Africa. *A station had to report 80% (60 days) or more of the days for inclusion. Countries with insufficient reports (no stations plotted) included: Guinea-Bissau, Guinea Sierra Leone, Liberia, Nigeria, Cameroon, the Central African Republic, Zaire, and Ethiopia. Pre been generally near normal (75-125%) across the southern portions (equator to 11°N) while n mal precipitation (<75%) has fallen across the northern portions (>11°N), particularly acro far eastern Sahel.*



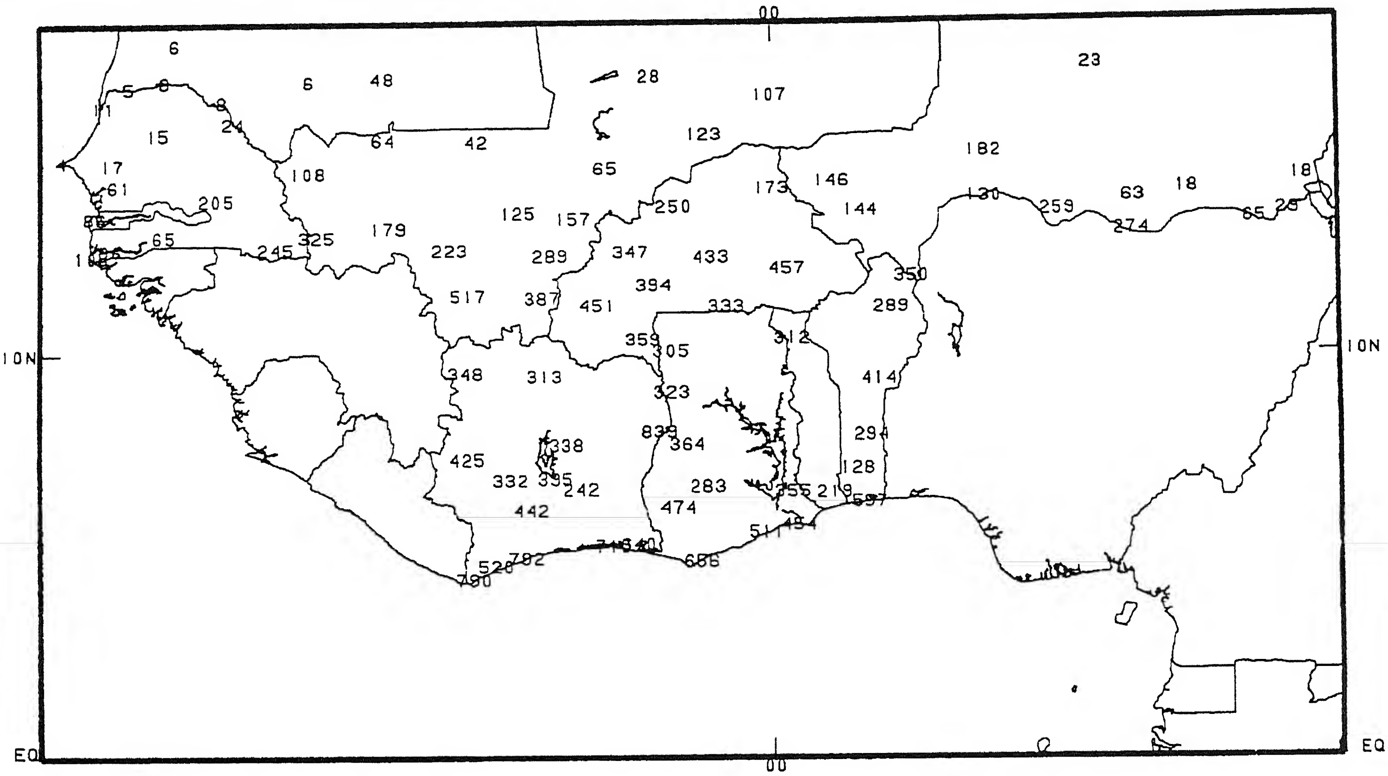
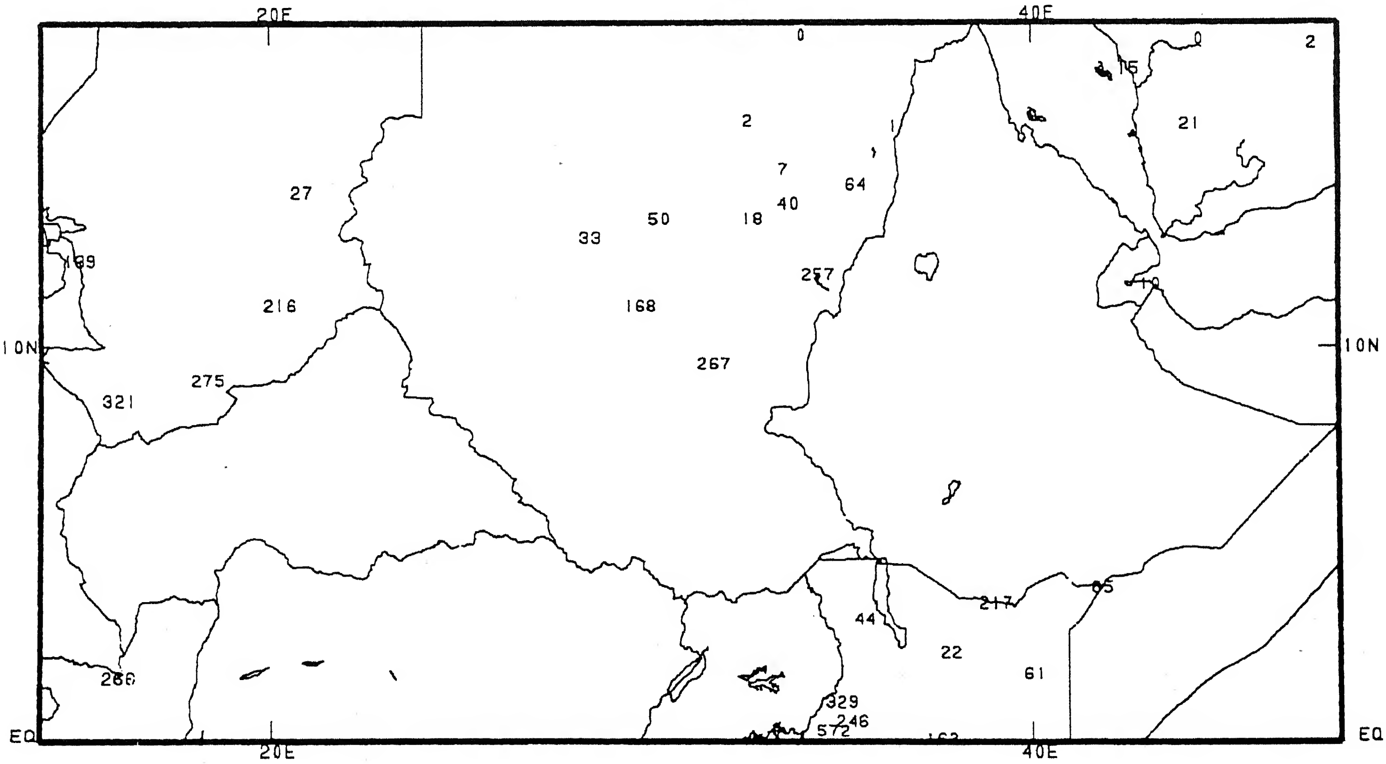


FIGURE 4. Total Precipitation (mm) During May 1–July 13, 1991 (74 days) For Western (top) and Eastern (bottom) sub-Saharan Africa. *A station had to report 80% (60 days) or more of the days for inclusion. Countries with insufficient reports (no stations plotted) included: Guinea-Bissau, Sierra Leone, Liberia, Nigeria, Cameroon, Zaire, and Ethiopia. Heavy rains (>400 mm) have been reported in Cote d'Ivoire, Ghana, Benin, Upper Volta, and southern Mali. In contrast, little rain has fallen on northern Senegal, southern Mauritania, and northern Sudan.*



SPECIAL CLIMATE SUMMARY

ANALYSIS AND INFORMATION BRANCH
CLIMATE ANALYSIS CENTER, NMC
NATIONAL WEATHER SERVICE, NOAA

UPDATE ON THE 1991 INDIAN MONSOON SEASON

Similar to the African Sahel rainy season, the Indian monsoon normally occurs during June–September, although significant rains may fall during the late spring and early fall months (April, May, and October), as was the case across southern and eastern India in 1991. The northernmost extent of significant monsoonal rains typically progresses rapidly from the Bay of Bengal and southern Bangladesh northwestward to central and west–central India during the first half of June. During the next month, the rains progress more slowly northwestward, reaching central Pakistan around mid–July (Figure 1). By the start of September, however, the monsoon has normally already withdrawn southeastward out of Pakistan, retreating to extreme southern India by the end of October.

During the 5–month period of May through September, more than three–quarters of the annual average rainfall is typically measured across most of India and Bangladesh, except along much of the eastern coastline, across central and southern sections of peninsular India east of the Western Ghats, and in Kashmir (Figure 2). Across central and west–central India and along the western coastline, more than 90% of the annual rainfall is typically measured during the aforementioned 5 months. As depicted in Figure 3, the western coastline, extreme eastern India, and southern Bangladesh experience the most intense monsoon activity (over 2000 mm of rain during May – September) while the relatively short–lived monsoon in extreme western India deposits fewer than 500 mm during the same period.

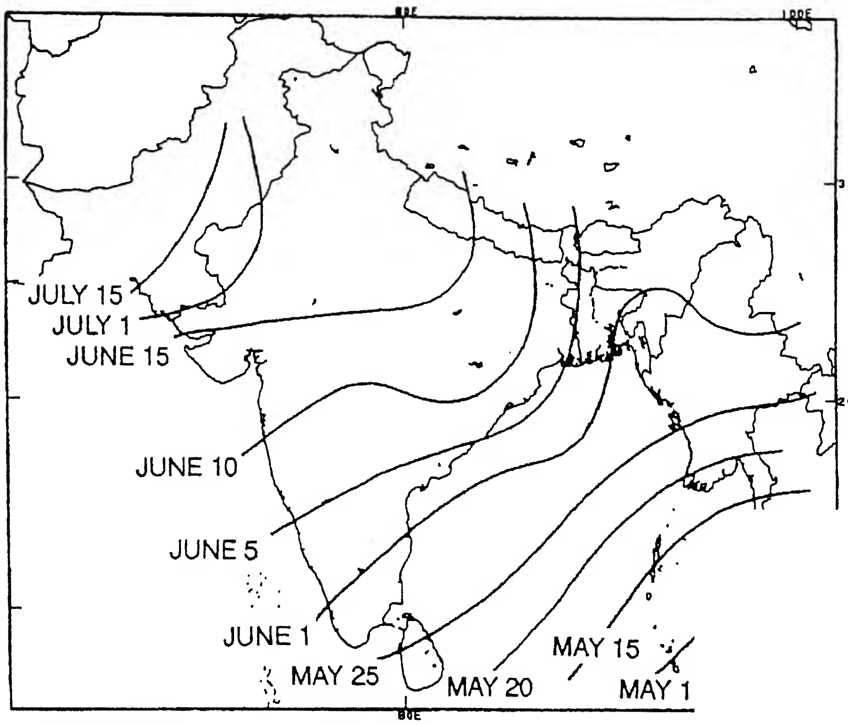


FIGURE 1. Mean Dates of the Southwest M
Northwestern Advance across Bangladesh, I
Pakistan from May 10 through July 15.

Prior to the normal start of the monsoon season, at the end of April, a powerful tropical cyclone (2B) formed in the Bay of Bengal and trekked northeastward, making landfall in southeastern Bangladesh late on April 29 with
gusting up to 315 kph. Acc
press reports, more than
lives were lost despite
warnings and atte
evacuations. An es
lion individuals we
and relief efforts
hamper

flooding a number of locations along the western coast. Amo
ern half of the western coast during the first full week of Jun
the Bombay area during the following two days, generatin
businesses to close early.

Inundating rainfall continued along the western coast through mid–July, with weekly totals of 100–300 mm common. During May 1 – July 13 (the monsoon season to date), 1200–2200 mm of rain had deluged the region. In addition, heavy rains that had tapered off somewhat across extreme eastern India during the last half of June re-developed in early July. The first two weeks of the current month brought 300–450 mm of rain to eastern Assam, where 1250–1430 mm have been measured since May 1 (Figure 4). Except for a few isolated locations most of peninsular India, extreme eastern India, and Bangladesh have experienced an abnormally moist monsoon season, with more than twice the normal rainfall recorded in western Maharashtra and coastal southeastern Andhra Pradesh (see front cover).

In contrast, most of central and northwestern India has experienced a dry monsoon season thus far as the northwestward progression of this season's monsoon appeared to stall shortly after mid–June. Central and western Gujarat, Rajasthan, and upper Uttar Pradesh have developed the most severe precipitation shortfalls during May 1 – June 15. Totals below half of normal are widespread, and several locations have recorded under 10% of normal during the period.

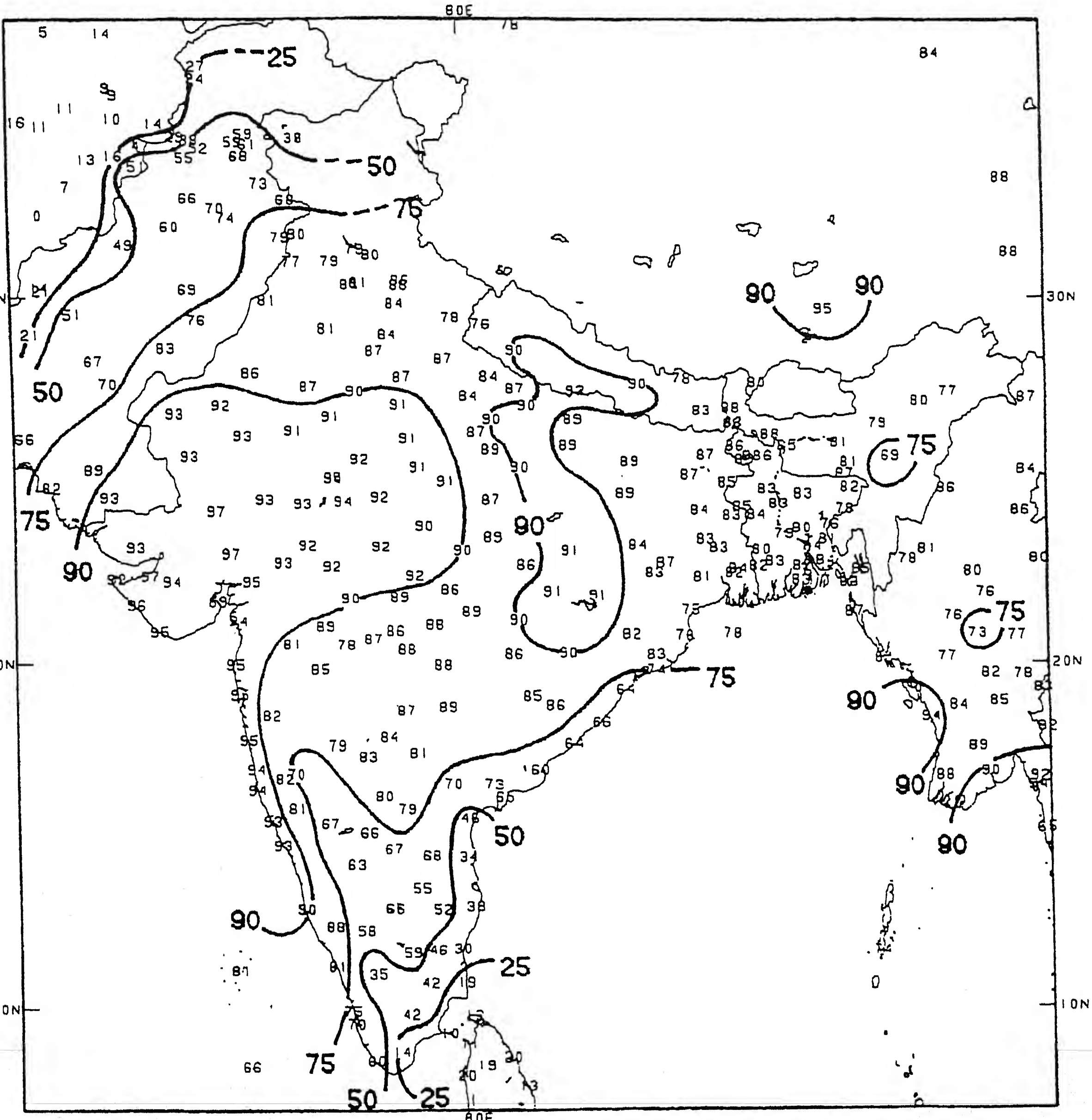


FIGURE 2. Percent of the Normal ANNUAL Precipitation That Occurs During May–September (5 months). *Isopleths are only drawn for 25, 50, 75, and 90%. If precipitation was evenly distributed during each month, then a 3–month period would have 25% (3/12) of the yearly precipitation, and a 6–month period would have 50% (6/12). During the 5–month period of May–September, over 90% of the yearly rainfall usually occurs across western and north–central India, with much of Bangladesh, eastern Pakistan, and most of the remainder of India normally receiving over three–fourths of its annual rainfall during this same period. As a result, this time of the year is critical for agriculture in much of the region.*

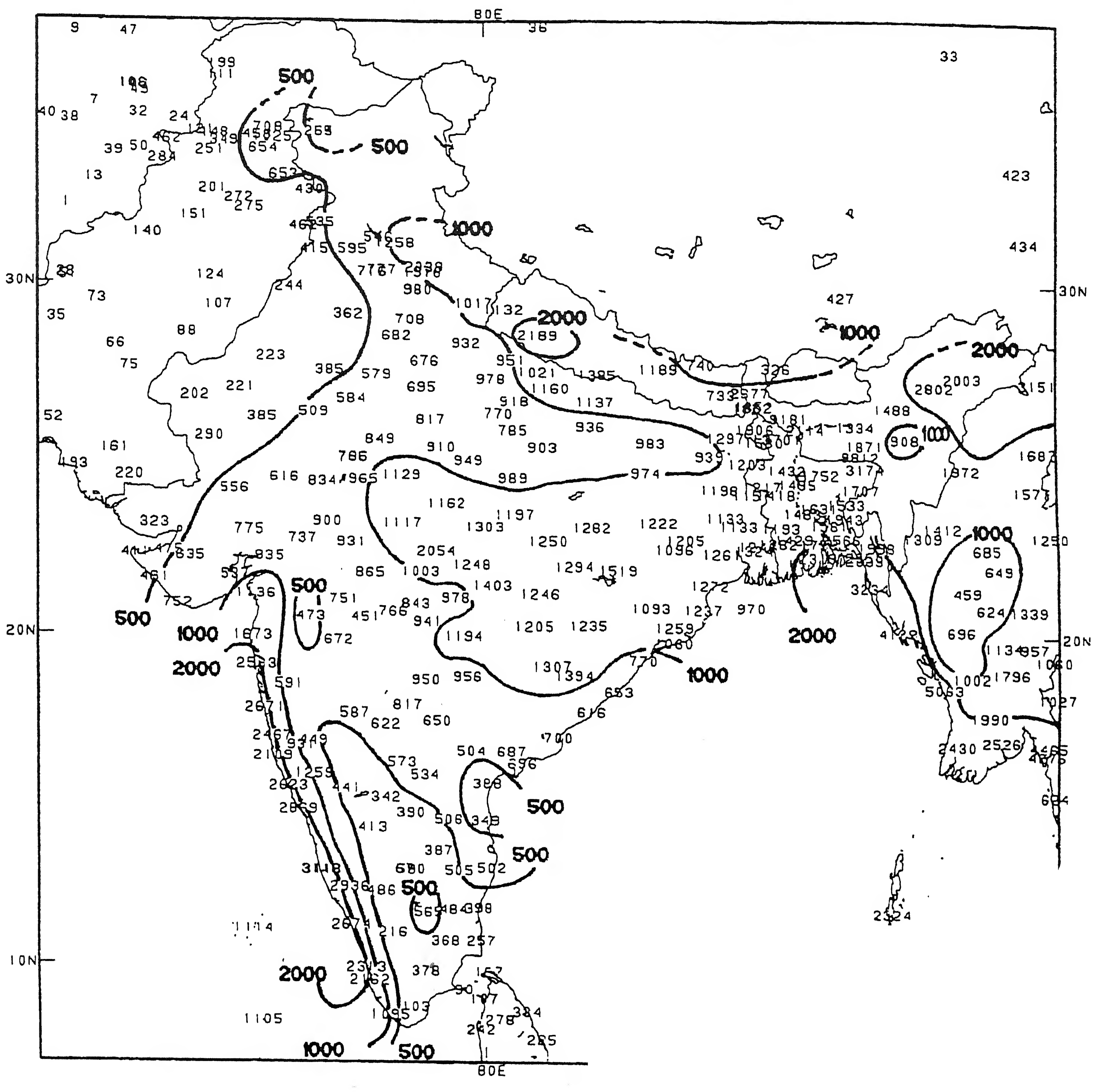


FIGURE 3. Total Normal Precipitation (mm) for May
and 2000 mm. The greatest amounts (>2000 mm) normally
southern coasts and in northeastern India's Assam state. Durin
from west to east and from south to north.

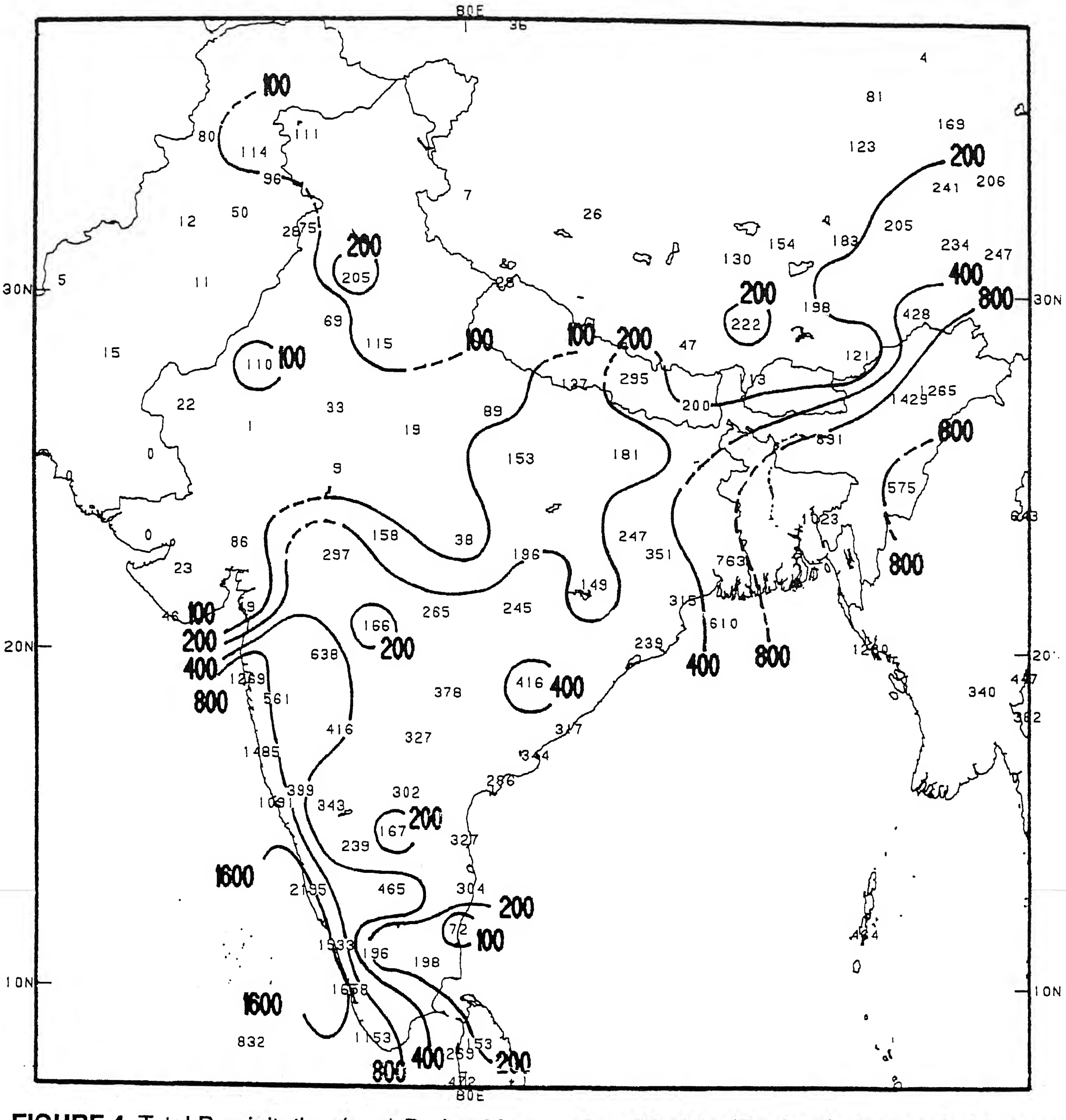


FIGURE 4. Total Precipitation (mm) During May 1 – July 13 1991 (74 days). *A station had to report 80% (60 days) or more of the days for inclusion. Isopleths are drawn only for 100, 200, 400, and 1600 mm. Torrential rains inundated the southwestern coast of India during the first half of June and the second week of July, where seasonal totals exceeded 1600 mm. Although reliable rainfall data in Bangladesh are lacking, press reports indicate that heavy rain was experienced last week. In sharp contrast, scant precipitation has fallen across much of pakistan and north-western central India as the nomsoon's northwestward progression has stalled since mid-June.*